G&G

Gem News International

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TUCSON 2018

Every February the gem and mineral world descends on Tucson, transforming the downtown convention center and a great many of the city's hotels into a fascinating collage of traders bearing goods from all over the planet (figures 1 and 2).

Many of the exhibitors we spoke with described 2018 as the strongest year since 2008. Although traffic wasn't especially heavy at the AGTA and GJX shows, most dealers there enjoyed brisk sales and healthy demand for high-quality goods. Some of the same trends from last year were evident. Customers still sought out one-of-a-kind pearls and colored gemstone pieces, and the secondary market in the U.S. for exceptional pieces remained highly significant. There was a continuing focus on untreated material and ethically sourced gemstones, a subject articulated for us by Jean Claude Michelou of the International Colored Gemstone Association and officials from the Responsible Jewellery Council. Market realities such as very strong price competition for newly mined gem rough were mentioned as a major challenge by many dealers and cutters.

In addition to strong demand for high-end gems, many dealers at AGTA and GJX reported a surge in more moderately priced goods. Meanwhile, dealers at other locations told us the commercial end of the market remained soft.

Pantone's color of the year for 2018, a shade of purple called Ultra Violet, was well represented at the shows. A couple of dealers had exceptional examples of purple sillimanite. Many dealers posted strong sales of pastel-colored spinel—in pink and lavender hues—in suites and sets as customers found the scarcity and high prices of red spinel prohibitive. In a similar vein, Margit Thorndal of Madagascar Imports reported strong demand for purple-lavender spinel and purple sapphire from Madagascar, as well as teal hues of unheated Montana sapphire.

We noted that electric blues, teals, hot pinks, hot yellow greens, and pastel-colored gems were quite popular. Bill Larson of Pala International pointed to this trend and showed us a number of spectacular examples from his inventory. Fine blue zircon from Cambodia was prominent, as was attractive sphene from Zimbabwe and Madagascar.

Dave Bindra of B&B Fine Gems said his company was very active in scouring the secondary markets for old jewelry items and gemstones that have been out of circulation

Figure 1. Although traffic at the AGTA show was lighter than in some previous years, demand was brisk and most traders were satisfied with their 2018 business. Photo by Kevin Schumacher.

Editors' note: Interested contributors should send information and illustrations to Stuart Overlin at soverlin@gia.edu or GIA, The Robert Mouawad Campus, 5345 Armada Drive, Carlsbad, CA 92008.

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Figure 2. Customers in Tucson sought out unique goods, a trend that carried over from last year's shows. Photos by Kevin Schumacher.

for decades. This year's standouts were two incredible red beryls from Utah (a 3 ct emerald cut and a 4 ct round brilliant), a 61.92 ct Imperial topaz (figure 3), and a fine selection of Kashmir sapphires, which were very sought after this year. Fran Mastoloni of Mastoloni Pearls updated us on current trends in the cultured pearl market and showed examples of unique pieces.

Dealers specializing in domestic gems reported strong demand. John Woodmark of Desert Sun Mining & Gems told us the market for Oregon sunstone was the strongest he had seen since the andesine controversy challenged suppliers of the natural Oregon gem a decade ago. As a result, the company has scaled up its mining activities and built new relationships with gem cutters to improve supply to its clients.

As always, the Tucson shows were a rich source for the latest on global colored stone supply. Conversations with Luis Gabriel Angarita and Edwin Molina revealed insights on the mining and branding of Colombian emerald. Marcelo Ribeiro shared details on mining and cutting at the Belmont emerald mine in Brazil. Alexey Burlakov offered his perspective on Russian demantoid production, while Stephan Reif did the same for demantoid from the Green Dragon mine in Namibia. Miriam Kamau shared information on her Kenyan tsavorite mining operation and offered her own inspirational success story. From Jürgen Schütz of Emil Weis Opals we learned about the cutting of opal, both play-of-color and nonphenomenal, from sources around the world. Alexander Arnoldi explained Arnoldi International's strategy in sourcing and cutting high-quality aquamarine and tourmaline. We also saw examples of gem production from unexpected sources: Indonesian opal and turquoise from the state of Arkansas.

Tucson is also a destination for many leading gem artists and jewelry designers. Award-winning carver Michael Dyber explained the inspiration behind some fantastic one-of-a-kind pieces bearing his signature optical disks. At the intersection of science and art, Rex Guo discussed his approach to recutting gems to optimize light performance and beauty. And designers Paula Crevoshay and Erica Courtney showed us striking and innovative new pieces with unexpected and fascinating gem combinations.

Duncan Pay
GIA, Carlsbad

Figure 3. Dave Bindra of B&B Gems showed us a selection of standout gems from the secondary market, including this 61.92 ct Imperial topaz. Photo by Kevin Schumacher.

COLORED STONES AND ORGANIC MATERIALS

Multi-generation cutting family from Idar-Oberstein. Idar-Oberstein, Germany is a historic agate locality that became famous over the last century as a colored stone trading and cutting center. In recent decades, though, much of the lapidary activity has moved from Idar-Oberstein to cutting centers in Asia such as Jaipur and Bangkok. The remaining businesses in Idar are focusing on highly specialized mar-

Figure 4. Aquamarine has long been Arnoldi International's signature stone. Photo by Kevin Schumacher.

Figure 5. More recently, Arnoldi International has begun working with tourmaline from the Democratic Republic of Congo. Photo by Kevin Schumacher.

ket segments, such as precision cutting and unusual stone varieties. Alexander Arnoldi explained to us the strategy of Arnoldi International and provided an update on some new high-quality materials.

The cutting business was founded in 1919, making Alexander Arnoldi a fourth-generation gemstone dealer and cutter. They process all the goods in-house, from rough sorting to final polishing. Lapidary work is still based on the traditional techniques of Idar-Oberstein, where the wheel is turned with the dominant right hand, leaving the left hand free to hold the stone. Laps are motor-driven today, but the stone is still held with the left hand. According to Arnoldi, it takes more than five years to master cutting and learn all the facet placements and correct angles for the different styles and materials.

The company focuses on flawless stones, a challenging segment of the gemstone industry. Prices for these goods have exploded, but supply is extremely low and competition at the source is very high. Finding extremely high-quality rough that yields large clean stones is one of the main challenges they face in the current market. Nowadays, most rough suppliers bring their goods to Bangkok and Jaipur instead of Germany. This forces companies such as Arnoldi to go source their own material on site—for instance, copper-bearing tourmaline from Mozambique.

Idar-Oberstein's first main product more than 500 years ago was agate, polished using hard sandstones found nearby. When Germany's population began moving abroad in the early nineteenth century, Idar's network became more global and gained access to the Brazilian deposits, which produced many quartz varieties. The German cutters became very adept at cutting and polishing the materials sourced in Brazil. Arnoldi focused on aquamarine (figure 4), a stone that remains their strong suit in 2018. Originally they worked with goods from South America, including the fabled Santa Maria deposit in Minas Gerais, Brazil. Much of the rough is now sourced in Central and East Africa, which produces deep blue material similar to Santa Maria aquamarine.

Another stone they are focusing on is tourmaline, including Paraíba, rubellite, and bicolor stones. In December 2017, they traveled to Central Africa to source the new tourmalines from the Democratic Republic of Congo (figure 5). This material comes in different shades of green, often in the same crystal. Pink crystals are occasionally found. Supply is highly irregular, and quality varies greatly.

Arnoldi International is putting their focus on high-quality, flawless goods and excellent cutting standards. This allows them to supply high-end vendors who often ask for unique, customized cutting styles.

Wim Vertriest
GIA, Bangkok

Update on the Green Dragon demantoid mine in Namibia. According to Stephan Reif, Namibia's Green Dragon mine is the largest continuously operating demantoid deposit. Green Dragon has a complete mine-to-market approach, handling everything from mining, ore processing, sorting, cutting, and grading to wholesale. They mainly supply the European market through Vienna and the Asian market through Hong Kong.

The mine was discovered in a remote part of southern Namibia in the 1990s and has been producing since the mid-2000s. In 2017, Green Dragon received a 25-year mining license for the deposit, offering stability as an incentive to invest in the mine. In the near future, mining will be scaled up and production will increase. This will provide a more consistent and attractive supply for buyers in the

Figure 6. Namibian demantoid retrieved from the Green Dragon mine and preserved in its host rock. Photo by Albert Salvato.

trade. As part of the 25-year mining lease, Green Dragon has committed to supporting the local communities.

Namibian demantoid mining is highly mechanized, using heavy equipment to extract the green garnets from their host rock (see figure 6). Monthly production varies between 15 and 20 kg. Of that, a little over 10% is considered gem quality and goes for faceting.

Color ranges from yellowish green to bluish green, and some darker brownish greens are also found. Demand for certain colors varies, but at the moment the yellowish "golden" colors are in highest demand by designers. For Reif, the ideal Namibian demantoid is a slightly bluish green gem full of fire and brilliance.

The combination of lighter color and very high dispersion sets Namibian demantoid apart from other green garnets. These properties also depend on the quality of cutting and polishing (figure 7), something Green Dragon has focused on in recent years by having their in-house lapidaries and quality control perform to a higher standard. Because clarity, color, and calibration standards are so tight, the yield is only around 9%.

Most of the production is in melee and small calibrated sizes, with fine singles being extremely rare. Fine-quality melee is in very high demand in Europe at the moment, especially in the 4.0–6.5 mm range. In recent years, the demand for very small melee (1–2 mm) has increased substantially. Larger exceptional pieces typically go to Asia.

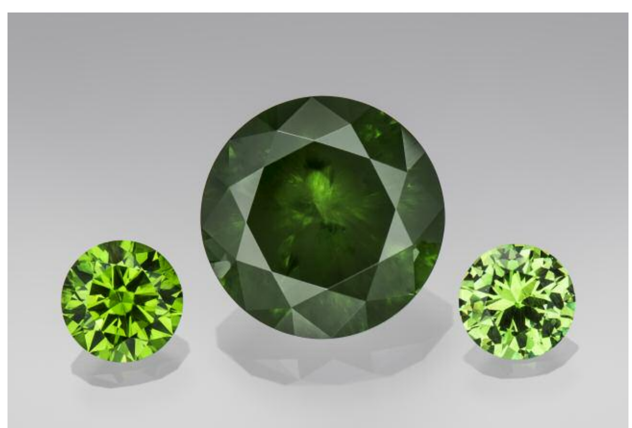
Wim Vertriest

Figure 7. The cutting and polishing of Namibian demantoid should emphasize the material's lighter color and high dispersion. Photo by Albert Salvato.

Update on Russian demantoid production. Russian demantoids (figure 8) are renowned in the gem community for their pure, vivid colors and spectacular inclusions. Alexey Burlakov, founder of Tsarina Jewels, shared some insights on the current production of Russian demantoids and emeralds. Tsarina Jewels is based out of Bangkok and was co-founded with his father, Dr. Evgeny Burlakov, curator of the Ural Geological Museum in Yekaterinburg.

According to Burlakov, there are currently two mines in the Urals producing demantoid in commercial quantities: Korkodin and Poldnevaya. They are about 7 km apart, located in the same geological massif that also hosts numerous gold and platinum mineralizations. Although the two mines are very close to each other, the material is very different. The Korkodin mine is characterized by a darker color, often with a brownish tint that can be removed by

Figure 8. Russian demantoids are well known for their pure colors and remarkable inclusions. Photo by Kevin Schumacher.



heat treatment. Poldnevaya produces material of lighter, more "open" colors without the secondary brown. Because they are naturally a pure green, these demantoids do not require heating to optimize the color.

A third known deposit is Nizhny, located in the Tagil region about 200 km north of the other two mines. This was the original deposit where Russian demantoid was discovered, but it is currently inactive. The material from this mine typically has a lighter color with a slightly bluish tint, setting it apart from the other two.

Russian demantoid comes in a wide range of colors, covering all shades of green. Much of the material has a brown color that can become dominant. The finest color is considered a pure, vibrant green with no secondary hues. It is estimated that around 80% of the Poldnevaya mine production has a secondary yellow color, while 15% is apple green and around 5% top vibrant green.

A typical feature of Russian demantoids is the horsetail inclusion, a radiating pattern of asbestos fibers. Fully developed horsetails are still rare. This inclusion has been found in demantoids from other localities as well, but none of these deposits match the importance of Russia's.

The main markets for Russian demantoid are the United States, China, and France. The French market demands smaller melee-sized stones, while Chinese and U.S. customers opt for stones over 1 ct. Prices of Russian demantoid have increased, especially for larger sizes. This is due to the limited production. It is estimated that the Poldnevaya mine produces between 300 and 1,000 carats of gem-quality material per month. This means that only a few stones over 3 ct are produced on a yearly basis.

Other important gemstones from the Ural Mountains are emeralds and alexandrites. The Urals produced large volumes of emerald in the beginning of the 20th century. During the Soviet era, the mines were reopened for beryllium mining. In recent years, emerald mining has started again. New production and specimens have already reached the market. The Russian emeralds are generally lighter green but clean compared to other deposits. Alexandrite is not being mined, but a Russian government corporation is actively developing and expanding the alexandrite/emerald mines in the Urals.

Wim Vertriest

Fortieth anniversary of the Belmont mine. This year marks the 40th anniversary of the Belmont emerald mine. Director Marcelo Ribeiro updated us on mining and cutting activities in Brazil and shared his thoughts on today's dynamically changing market.

As in 2017, mining activities are still focused on underground mining below the original Belmont open-pit site and the newly developed Canaan mine about 2 km away. In the near term, underground mining will continue to dominate emerald production. Ribeiro shared some new geological study findings related to multiple deposits in the Belmont area. Detailed geological analysis proved that over the past 40 years, only about one-fifth of the deposit within the Belmont property has been mined. Some exciting mineralogical study results from a mining site nearby hint at even deeper extension of the emerald-bearing rocks. Belmont has better wall rock stability than some other famous emerald sources around the globe. This makes underground mining an ideal option in the foreseeable future.

Figure 9. This 13 ct emerald represents some of the finest production material from Belmont's underground tunnel. Photo by Kevin Schumacher.

Currently, all rough emerald with a value of more than $20 per carat is faceted by Belmont's own cutters, while everything else is transported to Jaipur, India, for processing. The cutting facility at the Belmont mine now handles 1,500 to 2,000 carats of emerald per month. Ribeiro visited the factories in Jaipur in late 2017 and is very satisfied with the quality of goods produced from the rough he exports to India. In terms of adding value to the medium- to low-quality rough stones, cutters in Jaipur have more experience and expertise. According to Ribeiro, the company's sales jumped about 15% each of the past three years. A 13 ct top-quality emerald recovered in 2017 from the underground mine at the original site (figure 9) and a 15.01 ct stone from the Canaan mine (figure 10) were brought in by Ribeiro. The stone from Canaan showed a very special color reminiscent of the electric bluish green color of some copper-bearing tourmalines. This stone also displayed quite strong green and blue pleochroism. Ribeiro informed us that this is a very rare color and only a very limited amount of rough can potentially produce stones of this color.

Belmont has exhibited in Tucson for the past 17 years, and Ribeiro pointed out that the way of doing business has changed dramatically in recent years. The booth at the GJX show once generated about 80% of the company's sales. Now, 80% of the sales happen online. Ribeiro used to stay at the booth to sell stones, but nowadays he needs to spend most of his time walking around the show to talk to different people. When asked about the role of middlemen in the current and future marketplace, Ribeiro shared his opinion. When he first got into the trade, he envisioned that one day middlemen would be removed from the pic-

Figure 10. This 15.01 ct emerald from the Canaan mine had an unusual color, and many customers at the show thought it was a Paraíba tourmaline. Photo by Kevin Schumacher.

ture and he would market his stones directly to end consumers. With the industry experiencing dramatic changes these days, he has started to feel that middlemen will remain but must change their mindset to adapt to new ways of doing business.

The logistics network within the United States allows very fast, safe, and economically viable transportation of gemstones between dealers and jewelers. Overseas suppliers like Belmont do not have access to the same services, which makes it necessary to have an intermediary located in the States who can handle shipping, receiving, and securing stones between the supplier and the buyers. This person also works as a sales representative to connect the supplier and the buyers. Ribeiro pointed out that unlike the traditional middleman, this person does not do business by trying to hide the supplier from the buyers and vice versa. In fact, this representative should ideally make the supply chain even more transparent by letting the two ends easily see and connect with each other to build more solid trust, connections, and inventory in between.

For the past 40 years, the Belmont mine has practiced community building and empowered people through gemstone mining. Ribeiro feels that this is already embedded in the DNA of the company and will continue to guide their good work. He hopes that gemstone purchasing will remind younger buyers of the benefits these stones bring to the local people and their next generation.

Tao Hsu and Andrew Lucas
GIA, Carlsbad

Colombian emerald industry: The new generation. Following author AL's 2015 visit to Colombian emerald mines and cutting operations, we again had the opportunity to interview two representatives from this important source country. As part of the new generation of the Colombian emerald industry, both shared with us their experience and vision for the industry.

Luis Gabriel Angarita, director of the CDTEC gem laboratory in Bogotá, comes from a family that has been heavily involved in the industry for over 40 years. Since 2009, Angarita has been working on branding Colombian emerald. He recently resigned as president of the Association of Colombian Emerald Exporters and is working full-time for the gem lab. Angarita updated us on the large production coming from the Chivor mines. He said that while the production has been low for over 20 years, the quality of extracted stones is quite high.

Even though Angarita no longer heads the exporters association, promoting Colombian emerald as a brand is still at the top of his list of priorities. He sees several challenges in branding the Colombian emerald. First, the Colombian emerald industry lacks a well-accepted standard. This causes inconsistency between different players and makes it extremely hard to face the global market as a unified entity. Effectively educating consumers is another obstacle in branding. Angarita admitted that the Chinese market has the greatest potential for emerald. However, most Chinese consumers only want emeralds with no oiling. Goods with moderate oiling are almost unsellable. This misunderstanding of emerald value factors hinders the stone's promotion. Inconsistent description among major gem laboratories further complicates the situation. Angarita also shared some information about a new emerald treatment being developed in Colombia. Finally, he informed us that the second World Emerald Symposium will be held in Bogotá in October 2018.

Edwin Molina, a fourth-generation Colombian emerald miner, serves on the board of directors of the Cunas mine in Santa Rosa. He also became president of APRECOL (the Association of Emerald Producers of Colombia) in 2017. Molina's family has played a critical role in emerald mining in the Muzo area, and he was partially responsible for the transaction that formed today's Muzo International. The family later switched its interest to the Cunas mine, which has been a joint venture with foreign investors since 2009 and is now one of the biggest in the area. According to Molina, production from Cunas is quite large. Although the mine typically lacks the very high-end stones with large sizes like those from Muzo, the quality is very stable. Compared to other operations in Muzo, Cunas is more controllable because its entrance is located far from the extraction points. There are three emerald-bearing zones in the mining concession, and so far only one is being worked on. Therefore, Cunas still has plenty of potential.

Molina also related his experience during this profound transformation from a family business to a formal mining corporation. He admitted that at the beginning of this journey, building trust with the investors was a challenge due to lack of supporting data from previous miners and operations. When he became involved, a new emphasis was put on formalizing the operation through environmental protection, infrastructure construction, and mining community building. Molina informed us that the mine would focus on increasing production by working on more extraction points within the 0.6 km^2 concession. This is very important because foreign investment will dry up if the mine has no production for a prolonged period, as has happened before in the Muzo area. Another important factor in attracting and keeping foreign investors is the security of the mine and production. With the support of the national police, a local police department will soon be formed to help with security. Molina has always believed that the only thing investors need to worry about is the production of a mine. As a miner and businessman who grew up in the United States and went back to his motherland of Colombia, Molina wants local miners to go out and see the world. Putting the industry in a global framework will enable them to adapt to a new environment and seize new opportunities.

During the interviews, both Angarita and Molina expressed confidence in the future of the Colombian emerald industry and optimism about global demand for this "Mother Gem" of Colombia.

Tao Hsu and Andrew Lucas

***Zoning In on Liddicoatite* exhibit.** The calcium-rich lithium tourmaline liddicoatite was first recognized as a new mineral species in 1977. It was named by research staff at the Smithsonian Institution after GIA's then-president, Richard T. Liddicoat (1918–2002). In honor of Mr. Liddicoat's centennial birthday, the GIA Museum hosted an exhibit titled *Zoning in on Liddicoatite* at the Tucson Gem and Mineral Show, February 8–11. With highlights from Mr. Liddicoat's career alongside crystals and polished crystal slices showing spectacular color zonation (figure 11), the exhibit was a fitting tribute to GIA's own "Father of Modern Gemology."

Jennifer-Lynn Archuleta
GIA, Carlsbad

Outlook on opals from Mexico and Australia. Emil Weis Opals (Idar-Oberstein, Germany) opened its doors in 1905, making it the oldest opal cutting company in the world. Idar-Oberstein was the only global gem cutting center at the time, and opal buyers from all major gem markets had to send rough there for cutting. Emil Weis catered to this niche market early on and has since branched into mining; the company now owns mines in Australia and Mexico. We sat down with Jürgen Schütz, part of the founding family at Emil Weis, to discuss their activities in the opal market.

Currently the company is cutting 50 different types of opal from all over the world, the majority of it from Australia and Mexico. Emil Weis sells more nonphenomenal opal from these countries than it does play-of-color opal. The Mexican boulder opals they had on display were such an example. These specimens are cut to include both opal and rhyolite matrix, which some jewelry designers like to use in their pieces. According to Schütz, the nonphenomenal "fire" opal from Mexico (figure 12) is the only opal mined in quantity that is clear enough for faceting. It ranges from colorless to a dark red that is comparable with ruby. This type of material is available in large quantities and can even be calibrated.

Figure 11. At the 64th annual Tucson Gem and Mineral Show, the GIA Museum hosted Zoning in on Liddicoatite *in honor of Richard T. Liddicoat's 100th birthday. Photo by McKenzie Santimer.*

Schütz then discussed the shortage of and demand for Australian black opals (see figure 13). In the past, Japanese demand for black opals drove prices up, but when Japan's economy slowed in the early 1990s, prices fell and production slowed. However, recent rumors that Chinese markets are interested in black opal have doubled prices. Schütz showed us a rare black opal suite from Lightning Ridge, Australia, which took years to collect. Emil Weis

Figure 12. Mexican fire opal is clear enough to be faceted, and ranges from colorless to dark red. Photo by Kevin Schumacher.

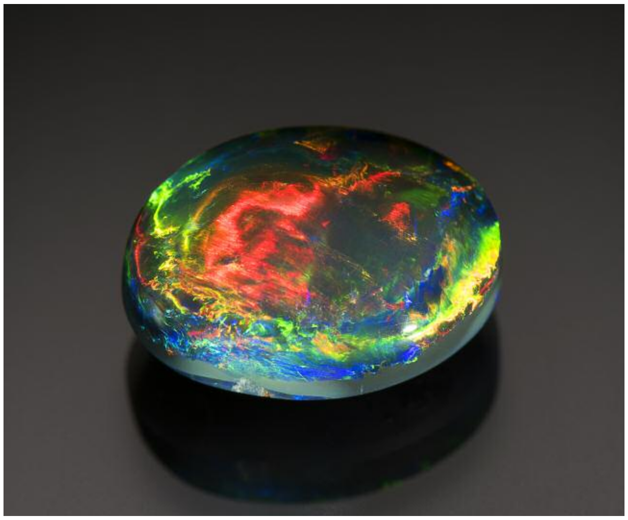
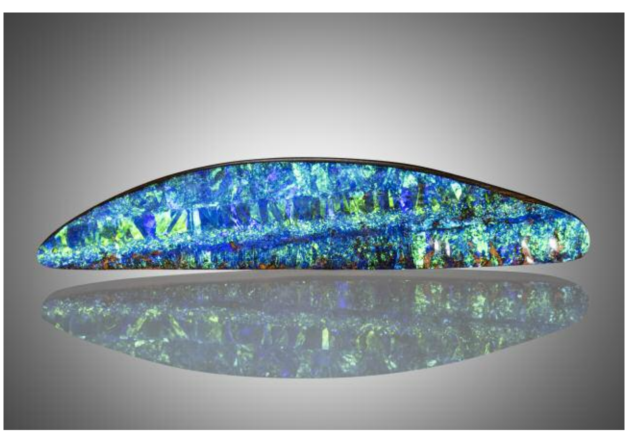


Figure 13. Jürgen Schütz discussed the current supply and demand dynamics of Australian black opal. Photo by Kevin Schumacher.

has had this suite for about 10 years; today, it would be impossible to assemble this combination of black opals due to low production.

Production of Australian boulder opal (figure 14) is quite low. This is partially due to weather conditions, but Schütz noted that the boulder opal belt of Queensland is about 3,000 km long and 800 km wide, with only about 25 people mining it. This means that medium- to high-quality material is not produced in quantity. Schütz himself has connections with some of the older Queensland miners who have held on to parcels. Over the past two years he has been able to buy a parcel at a time from them. As a result, Emil Weis has a huge stockpile of boulder opal to cut, but does so sparingly.

Figure 14. According to Schütz, the lack of active miners along the Queensland opal belt has led to a shortage of Australian boulder opal. Photo by Albert Salvato.



Schütz noted that the supply of South Australian light opals is also severely constrained. When Ethiopian opal came on the market at one-tenth of the price, the demand for Australian opal slowed. By the time buyers regained interest in South Australian opal, the mining population had dropped from several thousand to about 20 in less than a decade. In fact, Schütz said, Australian opal mining has traditionally been such a difficult way of life that many young people are opting for more stable jobs, leaving large gaps in the mining industry. He thinks that it may take another generation or two before mining once again hits its stride Down Under.

Duncan Pay and Jennifer-Lynn Archuleta
GIA, Carlsbad

Opal from West Java, Indonesia. At the AGTA show, Rare Earth Mining Co. (Trumbull, Connecticut) displayed an unexpected material: Indonesian opal reportedly from West Java. Two cabochons (figure 15) yielded a refractive index of 1.45 and a specific gravity of 2.13, consistent with opal. Energy-dispersive X-ray fluorescence (EDXRF) analysis revealed the presence of copper.

According to Rare Earth's Curt Heher, the material was first seen in the spring of 2017. While the opal comes in a wide range of colors, including browns and blues, the greenish blues were of particular interest. Rare Earth displayed cabochons where this was the primary hue, with the accessory colors distributed in an aesthetically pleasing manner.

Jennifer-Lynn Archuleta and Nathan Renfro
GIA, Carlsbad

Cultured pearl update. We had the opportunity to speak with Fran Mastoloni (Mastoloni Pearls, New York) at the AGTA show and hear his thoughts on the current status of the cultured pearl market.

Figure 15. These cabochons, weighing 6.94 ct and 3.79 ct, were among the Indonesian opals at Rare Earth's AGTA booth. Photo by Robison McMurtry.

Figure 16. The pearl market has seen a rise in popularity in pieces with unusual color (left) and size combinations (right). Photos by Kevin Schumacher.

According to Mastoloni, pearls continue to do very well. His company had one of its best fourth quarters in recent history, and he believes that has much to do with the pearl cycle. He noted that pearls tend to be in fashion in seven-year periods. Mastoloni believes this is the second year of a seven-year trend. Last year pearls were making a resurgence, but instead of classic white pearls they were selling unique and fashionable pieces, such as the cocktail necklaces of white South Sea, gold Philippine, and silvery Tahitian pearls seen in figure 16, left. Mastoloni explained that customers are enjoying the organic shapes and colors of these different varieties and how versatile such necklaces and pieces can be. This trend has continued into 2018, but they are selling these unusual combinations to designers and major manufacturers rather than individual stores. These clients are incorporating Tahitian or keshi pearls or stations into necklaces, as well as Mastoloni's colored pearl palette, with their own design elements. Mastoloni also noted a greater use of keshi pearls as stations, with one designer planning to use a bezel-set light sapphire between the stations to create something different, fun, and marketable.

Fine pearls continue to sell, though with a twist. Mastoloni's top sellers include white South Sea, Indonesian, and Australian pearls in classic styles such as long necklaces, but with a more organic appearance. The price point is very important, Mastoloni said, because a number of customers self-purchase for work or to satisfy their own tastes. In fact, he has found that self-purchasing of pearls has become more popular than gift giving. Pearls are versatile and can be worn anywhere, he said, because they communicate that the wearer is confident but not ostentatious.

Mastoloni showed us two graduated Japanese akoya necklaces that appear to date from the 1970s or '80s. The pearls measure 7.5 × 10.5 mm and are perfectly matched, with no imperfections and a nacre coating that is just not seen anymore; he has three other strands that are slightly smaller. These sizes are "almost unheard of" in akoyas and make for an unusual addition to a collection. He also showed his "cloud" necklace (figure 16, right), one of his most popular, created from Chinese tissue-nucleated pearls. Chinese pearls are sold by weight, and the cultivators are using larger nuclei to create larger pearls. Since pearls are no longer grown in the sizes used in this necklace, this material is unlikely to be found on the market despite its popularity.

Duncan Pay and Jennifer-Lynn Archuleta

Finds from the secondary market. During the AGTA show, Dave Bindra of B&B Fine Gems (Los Angeles) showed us some noteworthy pieces from a gem collection he acquired last year and shared his thoughts about the state of the colored stone market.

Bindra noted that B&B is very active in searching the secondary markets for unique material. Last year, they came into a significant collection from a client. Several of the items had previously been in B&B's stock, though the collection contains stones from all over the world. Among them are two incredible red beryls from Utah: a 3.01 ct emerald cut and a 4.08 ct round brilliant (figure 17) that is the world's largest round red beryl. Bindra considers these two of the most important red beryls on the market. Red beryl from Utah has been well out of production in these sizes for decades.

Another highlight was a 61.92 ct Imperial topaz of unknown provenance and free of heat treatment (again, see figure 3). The very rich sherry color in unheated Imperial topaz is extremely rare. That, plus the clarity and size, makes for an impressive stone of museum quality.

Also on display was a collection of 2–3 ct Kashmir sapphires, material that Bindra said customers are seeking, particularly in the Southeast Asian market. Kashmir sapphires have been out of production and even circulation for many years and are often found only at estate sales. Other remarkable stones from the collection included a 76.50 ct sphene with coloring reminiscent of a Christmas tree and a sugarloaf-cut 38.46 ct tanzanite (figure 18).

Bindra sees unprecedented demand for colored gemstones, particularly the high-end and unusual, making

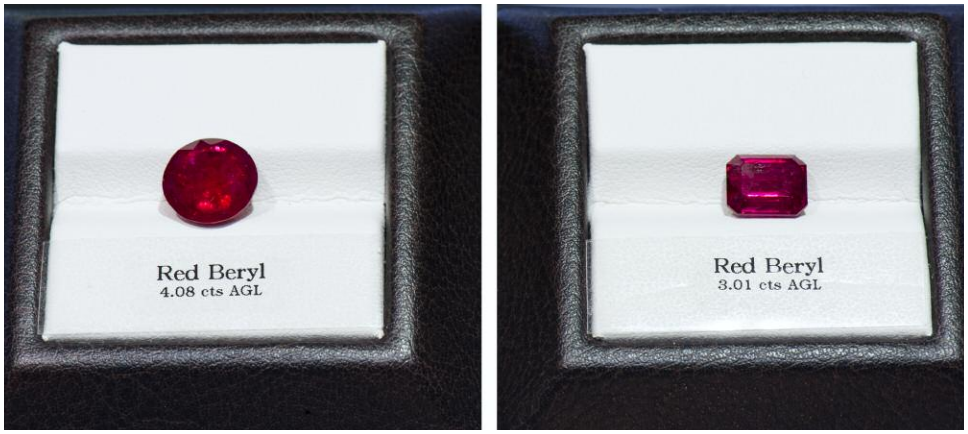


Figure 17. Two of B&B's most spectacular finds on the secondary market were these two red beryls from Utah, which has been out of production for decades. Photo by Kevin Schumacher.

this an exciting time for those who deal in the rare and esoteric. There are a number of factors at play, including the influx of new consumers domestically and abroad, particularly in Southeast Asia, though the Chinese market is less active than in previous years. Record-breaking auction prices are also driving up the value of colored gems. Bindra cited commercial-quality Mozambique ruby as an example; the very finest specimens from that country still command top prices. The highest-quality Mozambique rubies exhibit a subtle fluorescence, giving them a glow reminiscent of Burmese material. B&B has sold some of the extraordinary pieces that were featured in previous *G&G* Tucson reports. Bindra believes that many Americans have generated new wealth and view colored gemstones in the same way they see other tangible and collectible assets, such as luxury cars and fine art. This has been a great boon to the market. As Bindra noted, "The time for color is now."

Duncan Pay and Jennifer-Lynn Archuleta

Figure 18. Also part of a collection purchased from a client was this 38.46 sugarloaf-cut tanzanite. Photo by Albert Salvato.

Ponderosa sunstone update. John Woodmark, president of Desert Sun Mining & Gems (Depoe Bay, Oregon), provided an update on the Ponderosa mine. According to Woodmark, the mine is Oregon's most prolific sunstone source, producing about 95% of all material currently on the market. He explained that the mine's operations have changed to compensate for the characteristically short May-to-October mining season at the Ponderosa, which is at an elevation of 6,000 feet. In September 2015, Woodmark contracted with a sand and gravel company to bring a much larger excavator on site along with a high-capacity screen. This allowed the operators to stockpile a large enough volume of concentrate to sustain production through the entire following season.

In years past, even though the miners had access to the site as soon as the snow cleared in mid-May, they had to wait for the ground to dry out before they could mine. Now they can process the prior year's stockpiled concentrate through a wet trammel—which removes some of the volcanic crust on the rough feldspar—and pickers can start work immediately. The new process ensures more production: During the five-month 2017 season, Ponderosa produced 4,400 kg of rough labradorite feldspar.

In September 2017, the combination of the bigger excavator and the high-capacity screen produced approximately 5,000 cubic yards of concentrate in just under a month. Woodmark estimated that the concentrate contains 5 kg of Oregon sunstone per cubic yard, and the new process has dramatically increased production of Ponderosa sunstone.

Another development has been extensive test digging to determine gem potential over Desert Sun's existing 60-acre claim. Woodmark explained that these test digs located a promising area of approximately one quarter of an acre, which has been developed into an open pit about 50 feet deep. Woodmark's miners are finding larger stones as they go deeper, including one that weighed approximately 1,800 ct (figure 19). In addition, many of these larger gems are red/green dichroic stones, along with approximately 18 kg of extremely rare fine red and orangy red material (figure 20).

Woodmark has streamlined the company's operations in other ways. He now contracts with a cutting house in India that grades the rough gems into categories. This frees

Figure 19. A new test pit on Desert Sun's Ponderosa claim has produced much larger rough, with a high proportion of large dichroic stones. The largest recovered so far was approximately 1,800 ct. Photo by Kevin Schumacher.

Woodmark's team from having to grade and allows them to focus on mining and production. It also allows the cutting company to respond more quickly to customers' requests for a particular color or grade of finished gems. According to Woodmark, this development helps manufacturers use sunstone more effectively. He mentioned that sales have increased year-on-year since the andesine controversy earlier in the decade as trust in the natural-color Oregon gem has increased. He noted that 2017 was the company's most successful year to date.

Woodmark noted that sustained production has been a major factor in this renewed confidence. He also told us that recent interest in North American gemstones, especially among TV merchandisers, has driven sales. He says that when clients see the quality of an untreated red Oregon sunstone and compare the pricing for a one-carat stone to that of an equivalent-color ruby or spinel, they realize the $150-per-carat price tag is an absolute bargain.

Figure 20. Oregon sunstone retains its rich orangy red hues even in smaller sizes. Photo by Kevin Schumacher.

Figure 21. Desert Sun hires Native American teenagers from the local community to separate sunstone from ore. Photo by Duncan Pay.

Woodmark added that consumer concern about the integrity of the gem supply chain has fostered interest in domestic gems. People are looking for gems that can be followed "from the dirt to the finger."

Desert Sun Mining & Gems hires local Native American teenagers to help pick the sunstones from the processed ore (figure 21), which helps the local community. Woodmark explained that each picker can typically produce between 10 and 11 kg per day, but some might pick as much as 17 kg. He mentioned that the company had recently raised the pickers' hourly wage by 20%, citing the community unemployment rate of 87%. He told us, "They're always available…and they're good kids."

Woodmark told us the operation had recently hosted a PhD geoscience student from Washington State University who was studying the volcanism of the area. The student determined that the flow that hosts the sunstone at Ponderosa is approximately 18 million years old, and that the mine sits atop a vent, which is why those searching for similar deposits nearby have yet to find anything. As Woodmark said, "It just came up, and we're right on it." He added that the deposit "looks inexhaustible. From the bores that we've done, we have over a trillion carats."

Duncan Pay

Interview with a Kenyan miner and dealer. Miriam Kamau, owner of Mimo Gems Traders Ltd. in Nairobi, transformed from an office assistant to a dealer and miner to a representative of her country on the international stage of the colored gemstone trade. Her career has not only changed her life but also inspired many women in Kenya to pursue their dreams in the gem and jewelry industry.

Born and raised in Nairobi, she entered the trade working for an American gem dealer in her hometown. In the beginning, she greeted the clients and took care of errands for her boss. She gradually realized the big fortune these small stones can carry as she passed the stones and money between the dealer and his clients. Kamau started to pay more attention to trading activities in the office and ask more questions. Luckily enough, her boss generously shared his knowledge of the gems he dealt and did not mind her interacting with his clientele and even doing business with them. When he was away and the rest of the office staff was gone for the day, Kamau visited the mining area to talk to the clients, generally women, who brought stones to the office. She learned a lot from these female miners. She also realized she needed to go back to school for a formal education on gemstones. This led her to enroll in courses in Nairobi and Johannesburg to systematically study diamond and colored gemstone identification.

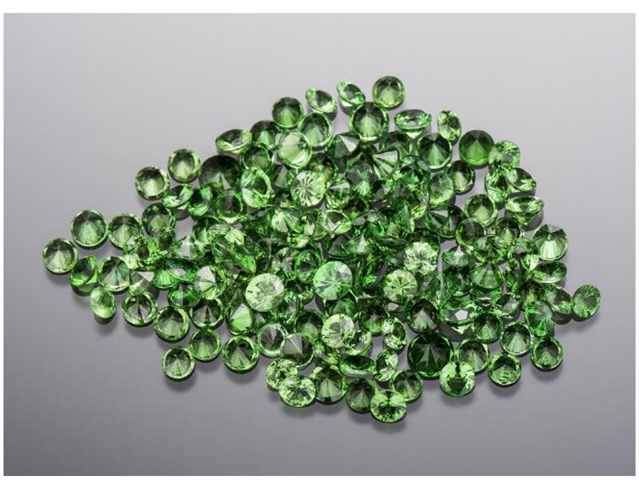
After returning to Kenya, Kamau started her own gem business in Nairobi, buying from the miners and selling wholesale and retail. During this time, she got to know many important people in the industry, including the late Campbell Bridges. Finally, an opportunity came to represent a Kenyan woman dealer who exported stones to Thailand. Kamau, who wanted to travel overseas, did not let this opportunity go. This trip opened her eyes to the world outside of Africa. Her trade contacts then introduced her to the International Colored Gemstone Association, and she became the ICA ambassador to Kenya. In that role, she gained the trust of Kenyan local miners to represent their interests.

As she seeks to bring added value to the local miners, her own business has expanded. She now has her own tsavorite mine in Kenya. She informed us that the mine's operation tunnel is about 90 feet deep, and the first extractions have been quite exciting (figure 22, left).

Kamau admits that when she started her own business, she experienced prejudice in the Kenyan trade, which has traditionally been dominated by men. Only very recently did Kenya begin to grant mining licenses to women, which allowed her to own an operation. While it is often considered unsafe for women to work in remote mining areas in Africa, Kamau readily adapted to the bush life and built a thriving business. She now works with her brother and other male miners in the mining operation.

As more women in Kenya learn about Miriam Kamau, many of them ask her for career advice. Kamau is now a key member of a Kenyan association dedicated to empowering women in mining. Kamau helped organize the first gem and jewelry show devoted to Kenyan women in the trade. The second show will take place in July 2018. Kamau is very optimistic about Kenya's future as a gem trading hub in Africa. She says the government is very supportive, and she sees a lot of positive changes happening in the mining sector. Kamau also brought with her some

Figure 22. Left: These faceted tsavorites were extracted from Miriam Kamau's mining operation in northern Kenya. Right: Kamau also brought Kenyan red spinel to Tucson. Photos by Kevin Schumacher.



spinel (figure 22, right) and fancy sapphire from the same area where she mines tsavorite.

Tao Hsu and Andrew Lucas

Turquoise from western Arkansas. At their AGTA booth, Avant Mining (Jessieville, Arkansas) displayed an unexpected material: turquoise from Polk County, Arkansas. According to owner James Zigras, this is the only gem-quality turquoise deposit in the U.S. located outside the Southwest. Calibrated goods and specimens ranging from blue-green to greenish blue were on view (figure 23). Also at the booth was a 245 lb. boulder unearthed in 1982 and polished in 2018 by Michael Beck (Copper Canyon Lapidary & Jewelry, Sedona, Arizona). The boulder, shown in figure 24, is the largest known American turquoise nugget.

The source was first mined from 1978 to 1986 under a previous owner, but the material was likely sold as Southwestern turquoise. During these years, there was too much competition in the market for stabilized turquoise, and activity eventually ceased. In 2017, Zigras bought the previous owner's estate, which included two tons of turquoise rough, and restaked a claim on the original mining site. He expected the source to yield planerite and was surprised to find that the material was close to ideal for the turquoise end member of the planerite-turquoise solid solution series. In January 2018, a test trench was worked for seven days. In that time, the deposit produced approximately 1,000 lbs. of turquoise and an old mine shaft was uncovered. Veins are located about 10 feet below the surface (see video at https://www.gia.edu/gems-gemology/spring-2018-gemnews-turquoise-from-western-arkansas). Quartz crystals and wavellite are also found in the deposit.

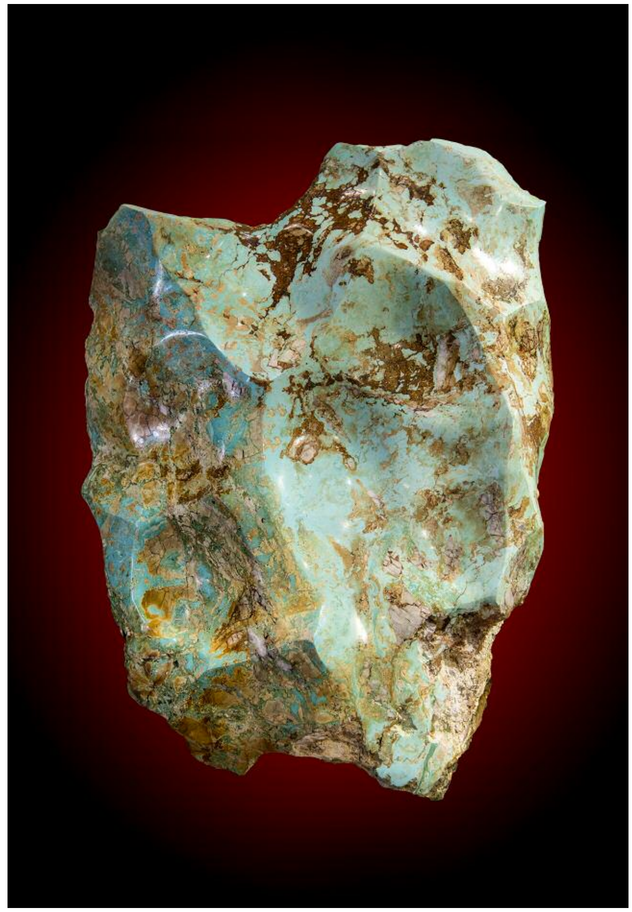


Figure 24. This 245 lb. boulder of turquoise, removed from the Polk County deposit in 1982, is the largest known American turquoise nugget. Photo by Robert Weldon/GIA.

Figure 23. Recent production from a reactivated turquoise deposit in Polk County, Arkansas. The beads shown here measure up to 25 mm in diameter, while the largest cab weighs 30 ct. Photo by Robert Weldon/GIA.

Zigras indicated that the turquoise is impregnated but not dyed. Independent testing at GIA confirmed impregnation; no evidence of dye was detected on the samples. Zigras plans to submit the material for Zachery treatment, a process designed to improve the polish and color of turquoise. It will be interesting to see this source's output in the coming years.

Jennifer-Lynn Archuleta and Nathan Renfro
GIA, Carlsbad

Unheated and unusual colors. Margit Thorndal of Madagascar Imports, Ltd. (Laurel, Montana) was one of several AGTA vendors carrying small stones in today's hottest colors. Thorndal showed two of her most popular stones from Madagascar: lavender spinel from the Bekily region and purple sapphire from Ilakaka (figure 25). Both materials are unheated and represent unique colors, particularly the lavender spinel.

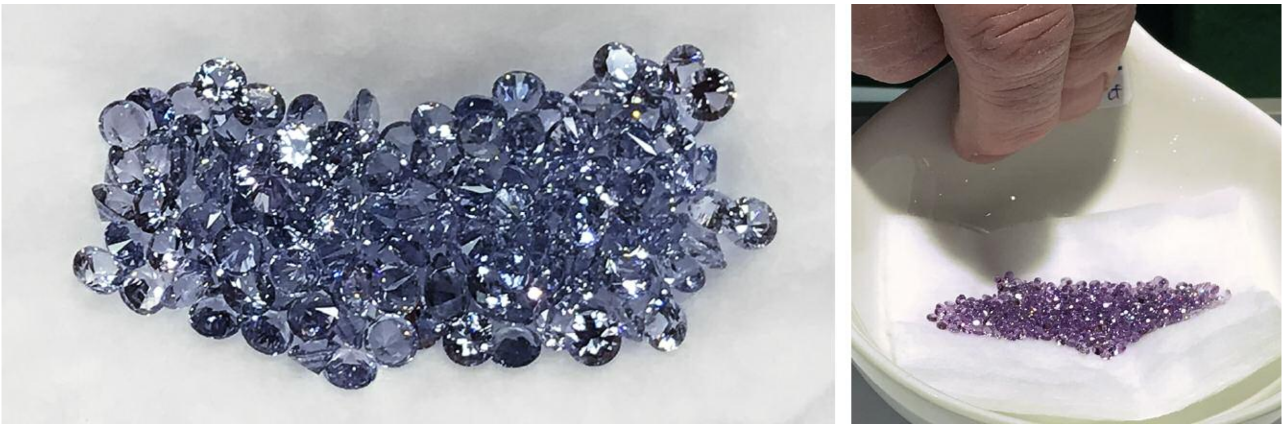


Figure 25. Madagascar Imports exhibited an array of small unheated stones, including 3.3 mm round brilliant lavender spinel from the Bekily region (left), and 2.5 mm round brilliant purple sapphire from Ilakaka (right). Photos by Jennifer Stone-Sundberg.

Thorndal indicated that buyers appreciate the unheated and nontypical colors. Along with purple stones from Madagascar, she has been doing very well with pink and orange Malaya garnet from the Bekily region and bright yellow-green demantoid. The rough from Madagascar is all precision cut by hand into melee at a single facility in Bangkok. The finished stones are used by designers creating one-of-a-kind pieces, jewelers performing custom work, and manufacturers producing higher-end goods. She also showed a suite of 21 unheated Ilakaka sapphires totaling 22 carats that displayed attractive pastel hues (figure 26).

Another item that has been doing very well for Madagascar Imports is unheated Montana sapphire, particularly in teal hues, a sentiment echoed at many other AGTA booths. There is strong demand for American gemstones, particularly untreated ones.

Jennifer Stone-Sundberg
Portland, Oregon

Vibrantly colored gems. Pala International (Fallbrook, California) reported a very strong AGTA show, a common sentiment among vendors there. This was clearly evident to us, as many buyers were actively looking at and purchasing items while we were at the booth. Popular colors on display at Pala matched what we saw elsewhere at the show: electric blues, teals, hot pinks, hot yellow-greens, and pastels.

When asked what was new, Bill Larson showed us a suite of spectacular sphenes mined in 2017 from Zimbabwe, ranging in size from about 5 to 40 ct (figure 27, left). The response to this material was very positive, and one of the pieces had already sold on the first day of the show. Larson also showed us two exceptionally fine purple sillimanites (figure 27, right).

Electric blue stones were popular throughout the show, either loose or in jewelry items. At the Pala booth we noticed many examples such as blue zircon and chrysocolla (figure 28), as well as Paraíba tourmaline and neon apatite.

Figure 26. Suite of 21 unheated Ilakaka sapphires, approximately 1 ct each. Photo by Jennifer Stone-Sundberg.

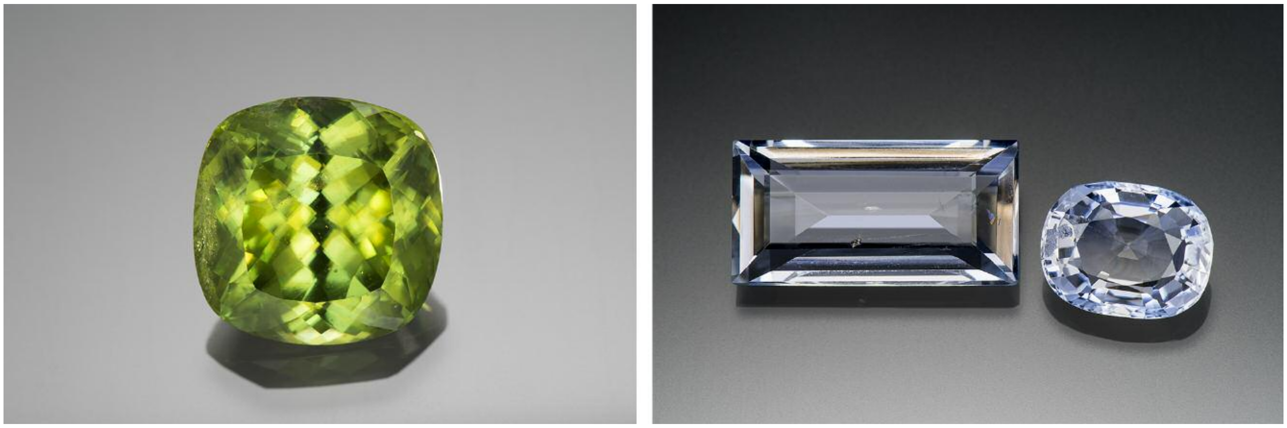


Figure 27. Left: A 24.96 ct cushion-cut sphene from Zimbabwe. Right: Two exceptionally fine sillimanite gems: a 10.39 ct baguette from Sri Lanka and a 4.81 ct cushion cut from Myanmar. Photos by Kevin Schumacher.

Also popular were electric pinks in the forms of rhodochrosite, pezzottaite, sapphire, and spinel.

Non-nacreous pearls were also to be found in both the AGTA and GJX shows, such as the large round Melo pearl offered by Pala (figure 29).

Jennifer Stone-Sundberg and Kevin Schumacher

CUTS AND CUTTING

Michael Dyber's innovative gem carving. Michael Dyber (Rumney, New Hampshire) discussed how 30 years as a gem artist have influenced his techniques and informed the creation of his optically stunning carvings (figure 30). He believes his method is a gift, one from the heart, and knows that his approach would not suit everyone's style.

Dyber prefers to pay premium prices for flawless material, as flaws that cannot be removed during preforming affect the polished piece's entire appearance. He finds sourcing rough to be a challenge and buys select pieces rather than lots of material. He also makes his own tools in his studio. When starting a piece, he chooses the rough by intuition and begins preforming the stone on a large grinding wheel by removing sharp edges and letting the lines and sides join together naturally. After preforming, he sits at the wheel with his handmade diamond tools and looks for inspiration in the piece, which he might find in the shape or an inclusion.

"So instead of trying to force a design into the stone," Dyber explains, "what I end up doing is sitting and looking at it and deciding, 'Let's start here,' and not having to think about where it's going to go. By doing this, and having this open-minded, I'm not confined." Dyber works with the stone in three dimensions—from the front, back, and sides—without any dopping or affixing to a surface. He holds the stone throughout, even during the four-hour process of drilling each one-millimeter hole into a piece (figure 31); this allows for a more continuous workflow. He noted that the pre-polish is the most important step of all. Carving can be finished quickly, but the pre-polish requires a great deal of patience or else the scratches will remain in the piece for good. Over the past three decades, he has managed to reduce pre-polishing from six steps to three. While the work is time consuming, Dyber finds his work emotionally satisfying, because he gets to see the potential of the rough transform into the finished piece.

In the future, Dyber wants to keep refining his techniques so that his pieces stay simple without losing their dynamic. "That's the excitement of the work, what drives

Figure 28. Electric blues were seen, including a 36.11 ct blue zircon from Cambodia (left) and a 23.90 ct chrysocolla mined in the 1950s from the Old Globe mine in Miami, Arizona (right). Photos by Kevin Schumacher.

Figure 29. A large Melo pearl from Vietnam (43.40 ct). Photo by Kevin Schumacher.

me on. Just changing something I've done for years and seeing how it turns out. Sometimes it's that simple."

Duncan Pay and Jennifer-Lynn Archuleta

Rex Guo: The science and art of recutting fine gemstones. Deciding how to cut a gemstone is inevitably one of the most difficult decisions when transforming a piece of rough into a fine faceted gem. The three main factors to consider are final carat weight, color, and light performance (a general term describing the brilliance and scintillation of a faceted stone). In most cases, optimizing one of these factors comes only by sacrificing something else. This is especially true for light performance, which often suffers at the expense of carat weight. The colored stone market has historically demanded that cutters produce goods with the highest possible weight in the finished stone. This often leads to cuts that are not designed to optimize light performance. In recent years, however, there has been an increasing demand in the high-end colored stone market for precision cuts and optimized light performance. This year at Tucson we had the chance to sit down with Rex Guo, whose Singapore-based Sutra Gems focuses on sourcing and systematically recutting faceted stones to unlock their inner beauty.

Guo is a self-taught gem cutter who came into this profession after spending 20 years working with computer graphics and video editing software. In 2015, he decided to take a sabbatical from software to pursue his passion for gemstones. The seed of his passion was planted during childhood, when he discovered an amethyst geode among a pile of sand in his schoolyard. This inspiration stuck with him and was fueled by years of formal engineering studies, which now serve as the backbone of his lapidary art. This technical foundation led to his realization in 2016 that optimizing the interaction of light with a faceted gemstone was exactly the sort of problem he had been working on for 20 years in 3D graphics software. Guo's mathematical mentor, the late Professor Timothy "Geometeer" Poston, was the inspiration for one of his latest creations, currently featured in the *Somewhere In The Rainbow* exhibit at the University of Arizona Gem and Mineral Museum. The Geometeer (figure 32), dedicated to Poston, is a precision-cut synthetic ruby in an innovative hybrid brilliant-Portuguese cut designed with Guo's proprietary gem design and optical simulation software, Axiom.

While Guo enjoys the privilege of cutting from fine gem rough, about 80% of his work is in recuts. Given the ever-increasing price of rough material, recutting provides an opportunity to work with very fine material that would otherwise be difficult to obtain. He starts with excruciat-

Figure 30. For 30 years, Michael Dyber has designed and fashioned gems, such as this aquamarine, in ways that please the eye and amaze the connoisseur. Photo by Albert Salvato.

Figure 31. Each hole Dyber drills into a gem, as in this Brazilian green beryl, can take up to four hours to complete. Photo by Albert Salvato.

Figure 32. The Geometeer, a synthetic ruby cut in a hybrid Portuguese-brilliant design, is dedicated to Rex Guo's mathematics professor and mentor, Dr. Timothy Poston. Photo by Rex Guo.

ingly accurate measurements of the geometry of the original faceted stone. Every angle of every facet must be recorded for input into Axiom. This software allows him to experiment with many possible recut designs to see how changing any single facet will affect the appearance of the final stone. Guo works very closely with his clients in this stage of the process to ensure they are getting what they want out of the recut. There are multiple paths that can be taken. The stone can be recut with an emphasis on saving weight, or a bolder design can be chosen with better light performance to bring out the stone's inner beauty, but with more significant weight loss. At this point Guo finds he has to walk a fine line between presenting himself as a master craftsman and as a scientist. While diagrams from his software are useful to show clients various options, he avoids coming across as overly technical so as not to detract from the emotional and romantic aspect of his craft. He quips, "Machines and software don't understand beauty—humans do."

Figure 33. Guo's light performance–optimized unheated blue sapphire. Photo by Rex Guo.

Guo is very much on a journey through the world of gemstone faceting. He started with round patterns, as most cutters do. Once he understood rounds, he moved on to optimizing trilliant and oval cuts. In the future, he plans to experiment with squares, rectangles, and more. The light performance–optimized cuts in which he specializes are best exhibited in high-RI materials. For this reason, he has set a minimum refractive index of 1.72 for stones he works with, a playing field that includes spinel, zircon, garnet, ruby, and sapphire (figure 33). Test cuts are often used before recutting important stones.

Spinels are one of his favorite stones to cut. The high RI and rich color of fine spinel produce stones that are "just divine." Zircons are another favorite, as they have a much higher RI than most other natural stones. With such a cornucopia of gem materials in front of him, Rex Guo's lapidary journey has just begun.

Aaron C. Palke
GIA, Carlsbad

Wim Vertriest

JEWELRY DESIGN

Designs from Erica Courtney. Erica Courtney has been adorning Hollywood stars for the red carpet for decades. Her eye for color and bringing out a stone's beauty are immediately apparent. In talking to her at the AGTA show, we discovered that she is the only jeweler in her family. She was introduced to jewelry making at the age of 11 through a Catholic Youth Organization class. This multiple AGTA Spectrum Award winner has always done things her own way, not following trends when choosing stones or creating designs. In fact, she confided that she does not plan what stones she will purchase, but lets the gems pick her. She likened the jewelry design process to a movie going through her head—designs start forming and keep changing until she settles on the final one.

Courtney's work pulls the viewer in to study meticulous details—the more you look, the more you see. Her attention to detail does not stop at the outward-facing front of her pieces. You need to turn the pieces around in all directions to appreciate the designs that spill over the edges and cover the sides and backs of her work. Returning to her point about the gems picking her, she stated that once a gem seduces you, "if you buy for love, you can't make a mistake." This is evident in the centerpiece stones in four of her creations. The Victoria pendant (figure 34, left) contains a 114.56 ct colorless topaz accented with a Tanzanian spinel from Mahenge and surrounded by more spinel plus rubellite, Mandarin garnets, and diamonds in an intricate gallery work. In the Autumn pendant (figure 34, right), a 47.16 ct Malaya zircon is surrounded by Tanzanian peach spinel, topaz, yellow sapphire, and diamonds. The Etoile ring's green African Paraíba-type tourmaline is flanked by blue Brazilian Paraíba tourmalines and diamonds (figure

Figure 34. Left: Erica Courtney's Victoria pendant showcases a 114.56 ct colorless topaz with a 2.76 ct Mahenge spinel set above it, surrounded by 86 Mahenge spinels, 20 rubellites, 10 Mandarin garnets, and 558 diamonds. Right: The Autumn pendant contains a 47.16 ct Malaya zircon accented with 3.91 carats of Tanzanian peach spinel, 7.00 carats of peach topaz, 1.31 carats of yellow sapphire, and 1.68 carats of diamond. Photos by Kevin Schumacher.

35, left), while the Imperial earrings (figure 35, right) contain perfectly color-matched Mandarin garnets flanked by pink spinel and diamonds. She confided that the electric orange and pink in the Imperial earrings was her favorite color combination of these four pieces.

Courtney's desire to understand the entire gem cycle from unmined rough to polished stones set in finished jewelry has taken her backpacking across far-flung locations. She described the experience as giving her an appreciation of how difficult it is to find real gems. She also took notice of the passion of the miners, each wanting to be "the one to have found it."

Jennifer Stone-Sundberg and Andrew Lucas

Preview of *Nature Art Science* with Paula Crevoshay. Paula Crevoshay described 2018 as an "opulent year" and showed us several new pieces that celebrate nature. Her remarkable use of color draws in and enchants the viewer.

Figure 35. Left: Courtney's Etoile ring has a 7.71 ct Paraíba-type tourmaline accented with 12 Paraíba tourmalines and 370 diamonds, all set in 18K yellow gold. Right: The Imperial earrings feature a pair of Mandarin garnets (21.25 total carat weight) accented with 1.87 carats of pink spinel and 0.71 carats of diamond in 18K yellow gold. Photos by Kevin Schumacher.


Figure 36. Left: Paula Crevoshay's Siberian tigress Baianai incorporates aquamarine eyes with black diamond pupils, 286 white diamonds, 168 cognac diamonds, and a 1.05 ct pink Oregon opal in 18K gold. Right: The "Morning Glory" brooch contains 272 Yogo sapphires, 90 purple sapphires, 45 pink sapphires (2.75 carats), and a 2.92 ct central moonstone, all in 18K gold. Photos by Kevin Schumacher.

She is working on a museum exhibition concept entitled *Nature Art Science*, with the intent of capturing how art is inspired by nature and how science is essential in the execution of art. Her work illustrates this concept, as the lifelike flora and fauna creations maximize the use of color and light while being solidly engineered and highly versatile.

Crevoshay displayed several realistic pieces depicting endangered animals, including the Siberian tigress Baianai (figure 36, left), whose mesmerizing eyes are composed of aquamarine with black diamond pupils. Baianai's nose is a hand-carved pink Oregon opal, and the rest of the 18K yellow gold jewel contains 286 white and 168 cognac diamonds. The hardware is engineered to allow the piece to be worn in many different ways. There are lush new flowers from Crevoshay such as the Morning Glory brooch (figure 36, right), which draws the observer into its center with an adularescent moonstone surrounded by a sea of 272 blue Yogo sapphires. The hue shifts toward purple and pink with the use of 90 lavender and 45 fuchsia sapphires from the tips of the petals to the center.

Crevoshay's first cuff of 2018 (figure 37, left) is titled Moon Glow and features moonstones as well as blue zircon, iolite, and blue sapphire. She likened it to "painting with light." Another piece that spoke to this concept was a pendant containing a large and exceptionally fine 30.64

Figure 37. Left: Crevoshay's Moon Glow cuff contains 72.28 carats of moonstone, 36.68 carats of blue zircon, 8.58 carats of iolite, and 3.47 carats of blue sapphire in 18K gold. Right: The Gelila pendant features a 30.64 ct Ethiopian opal surrounded by blue zircon, pink tourmaline, tsavorite, apatite, ruby, and diamond melee. Photos by Albert Salvato.


ct Ethiopian opal (figure 37, right). The flanking of the opal's intense play-of-color hues with like-colored surrounding stones such as blue zircon, pink tourmaline, tsavorite garnet, apatite, and ruby made for a stunning and very aesthetically pleasing piece. Both works showcased many of the most popular hues we observed throughout the AGTA show.

Talking with the artist, we learned that her father was an engineer, an exposure that led her to design all of her own mechanisms (such as hinged bales), allowing the pieces to be worn in many ways, such as a pendant or brooch. From an artistic standpoint, Crevoshay has drawn inspiration from Schlumberger, Fabergé, and Lalique. Their influence is evident in her designs that are simultaneously intricate and fluid, while focusing on the use of light with the color of the incorporated materials. From the mesmerizing and magnificent details such as the hand-carved Oregon pink opal nose of her tigress to side stones mimicking the play-of-color of a precious opal, it is easy to understand why her work has attracted such a following.

Jennifer Stone-Sundberg and Andrew Lucas

RESPONSIBLE PRACTICES

Update from the Responsible Jewellery Council. The Responsible Jewellery Council (RJC) has announced plans to include colored stones and silver in the next revision cycle for its Code of Practices, which RJC members are certified against. The organization has begun updating its existing standards, a process that takes place every five years. These plans dovetailed with the release of the United Nations' 2030 Agenda for Sustainable Development, which outlines 17 goals and 169 targets for member nations to meet. The author sat down with Edward Johnson and Anne-Marie Fleury of the RJC during the 2018 Tucson gem shows to discuss the status of these efforts.

The first round of public consultation, which focused on the scope of changes to the standard, took place in 2017. As of February 2018, RJC's Code of Practices were under review prior to a second public consultation phase, which targets industry and non-industry stakeholders, of proposed changes to the Code. These consultation phases are in line with RJC's annual auditing of their standard-setting approach, assurance framework, and measuring impacts program.

Like previous versions, the revised Code will certify business practices rather than products. The certification will cover all the important social, environmental, and health and safety issues in the jewelry supply chain. RJC's priorities for change, which must work for businesses of all sizes, involve several areas, including:

- Due diligence for responsible sourcing: RJC recognizes that traceability does not automatically translate to sustainability. As a standard for alignment with the Organisation for Economic Co-operation and Development, RJC encourages companies to adopt a due diligence approach to managing risks in their supply chain. Traceability remains a powerful tool for making responsible sourcing claims and is a voluntary certification option.
- Gender equality: RJC endorses best practices that promote diversity, including gender equality. To this end, it is partnering with Business for Social Responsibility (BSR), a nonprofit organization dedicated to sustainable business practices, to develop better guidance on gender equality in the gem and jewelry sector. Topics to be covered include working conditions, facilities, and approaches to family leave.
- Updating requirements on responsible mining: Many of the most challenging issues in the industry occur at the mining stage, and RJC continues to evolve its responsible mining provisions to address these challenges.
- Reducing audit duplication: As it continues to work with jewelry industry members of all sizes, RJC continues to harmonize with and cross-recognize other industry initiatives already in place from other organizations so that businesses do not have to duplicate efforts at their own cost.

The consultation phase of the Code of Practices review is scheduled to run from April to July 2018. Announcements about the process can be found at https://www.responsiblejewellery.com/standards-development/code-of-practices-review-2/.

Jennifer-Lynn Archuleta

Supply chain transparency and beneficiation. As the industry sees technology become more involved in daily gem trading and responsible sourcing has become a hot topic, Jean Claude Michelou, the editor-in-chief of *InColor* and a veteran of the industry, shared his perspective about supply chain transparency, beneficiation in source countries, and recent development of a Nigerian sapphire mining project.

While the diamond industry is already applying the blockchain concept, Michelou believes it is also the future of the colored stone counterpart. Blockchain and cryptocurrency both have the potential to increase the transparency of the colored stone supply chain by digitally recording all trading activities between different parties involved in the gem trade. He pointed out why miners, dealers, big brands, and consumers all need more transparency. The big jewelry brands especially need transparency to reinforce brand image and consumer confidence. Therefore, he expects the real changes will start with these companies, and gradually other players will be drawn in.

Michelou also sees the impending shortening of the supply chain, especially as new technologies such as mobile devices become readily available even in the very remote mining areas. Even though many do not welcome

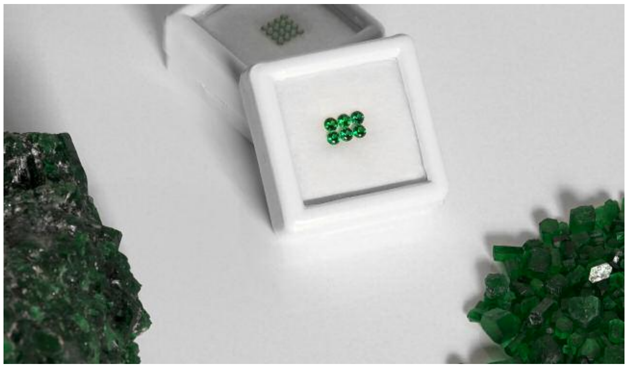


Figure 38. Swat Valley emerald yields fine precision-cut stones in small sizes. Photo by Albert Salvato.

the disappearance of the middleman between the supplier and the end consumers, it is unavoidable if no extra value can be added other than sharing the margin with both ends.

For the past decade, Michelou has taken part in several beneficiation projects initiated by multiple organizations. One project he is highly involved with is in the Swat Valley emerald deposits of Pakistan. Before he joined this project, a partnership between the local miners and a foreign company worked quite well for a three-year period. The company bought all the finished stones that were cut and faceted by local cutters. When this partnership stopped for unknown reasons, Michelou was contacted by locals who knew of his expertise.

There are three mines in Swat Valley. The one that this project is working on has about 80 to 100 individual tunnels. Trained local women, usually the wives of miners, can handle 1.5–3.0 ct round brilliant cuts very well. Michelou became the liaison between them and a luxury jewelry brand in Europe that offered these women training and paid them a $500 per month salary. If these rough emeralds were transported to Jaipur for faceting, the cost would in fact be lower. However, the luxury brands are willing to pay more to guarantee a transparent supply chain since it enhances their brand image for consumers who care about where the stones are from. It also improves their reputation with the local people. Even though many rough stones are still exported to other countries for further processing, at least a portion of them stay in Pakistan for services that benefit the community through employment and added value to the resource (figure 38).

Finally, Michelou talked about his involvement in a Nigerian sapphire mining venture. Although the project was delayed for eight months, it will be a large-scale operation with two washing plants. The first plant will have a washing capacity of 50 tons per hour. From his time spent in Nigeria and Pakistan, Michelou has rich experience working with the people at the source. He said that understanding the local culture is very important for any company or individual wanting to start a gem mining or trading enterprise in these source countries. His personal experience has told him that trying to adapt the local people to the Western way of doing business is a challenge, especially at the beginning stage of the collaboration. One must gradually prove to the locals that a different approach can produce results that will benefit them tremendously, and this will help to change their mindset.

Tao Hsu and Andrew Lucas

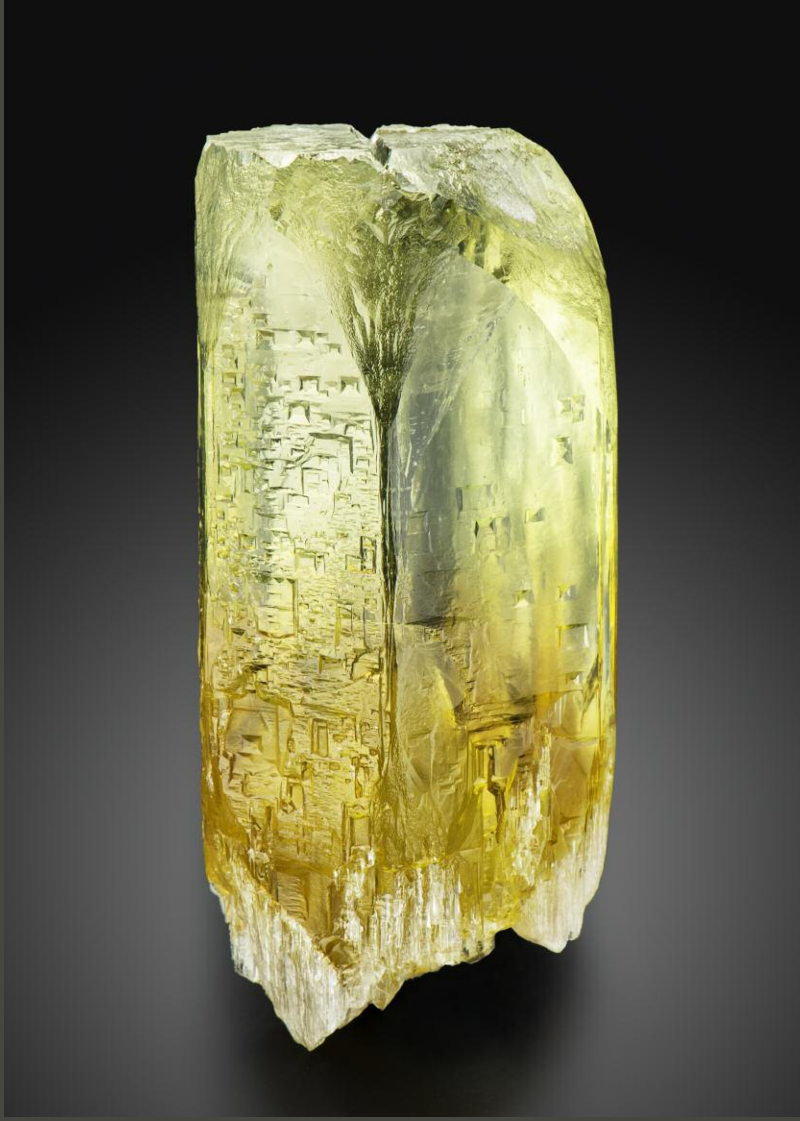
ANNOUNCEMENTS

Gianmaria Buccellati Foundation Award for Excellence in Jewelry Design. The first annual Gianmaria Buccellati Foundation Award for Excellence in Jewelry Design was presented on February 2, 2018, to GIA graduate Catherine Zheng (figure 39). The competition, open to students who successfully completed the GIA Jewelry Design course in 2017, recognizes artistic excellence in jewelry design. Zheng received the award for her rendering of an Art Deco–inspired pendant necklace. Zheng, who studied at GIA in Carlsbad, was one of 12 finalists from seven campuses whose hand-rendered designs were judged by a committee comprised of jewelry design, manufacturing, retail, and media experts. The finalists' designs were on display and the recipient of the award was announced at the annual GIA alumni party held during the AGTA Gem Fair in Tucson.

The Gianmaria Buccellati Foundation sponsored the award as a way to inspire beginning jewelry designers and honor the work of the renowned jewelry design house's founder, Gianmaria Buccellati. The 2018 competition is under way and open to students in GIA's Jewelry Design course who meet the eligibility requirements.

Figure 39. Gianmaria Buccellati Foundation Award winner Catherine Zheng (center), with GIA president and CEO Susan Jacques and Gianmaria Buccellati Foundation chief officer of North American strategies Larry French. Photo by Kevin Schumacher.

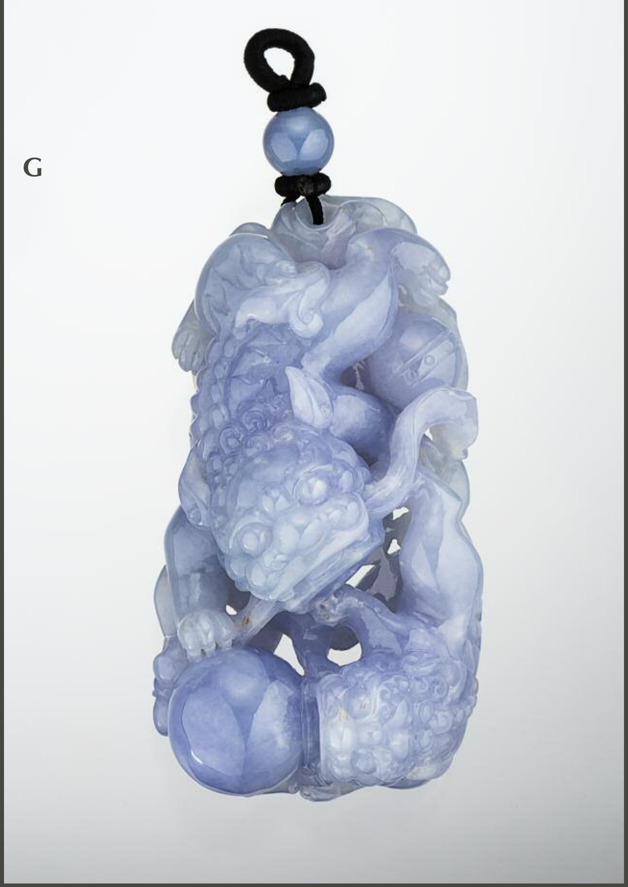
2018 Tucson Photo Gallery



A: Bicolor tourmaline frog carving by Daniela Becker. Photo by Robert Weldon/GIA, courtesy of William Larson. B: Bicolor beryl from Ukraine. Photo by Robert Weldon/GIA, courtesy of Quarts Samocveti. C: Emeralds from Zarajet, Afghanistan, 23.43 ct and 4.46 ct. Photo by Robert Weldon/GIA, courtesy of Himalayan Gems and Jewelry. D: 54.07 ct carved moonstone. Photo by Emily Lane, courtesy of K&K International. E: Ethiopian sapphire. Photo by Emily Lane, courtesy of Michael Couch.

F

G



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F: Rough bicolor topaz, 1.907 kg, from Ukraine s Volyn deposit. Photo by Robert Weldon/GIA, cour tesy of Quarts Samocveti. G: Lavender jade carving. Photo by Emily Lane, courtesy of Mason Kay.
H: 7.72 ct black opal from Lightning Ridge, Australia. Photo by Robert Weldon, courtesy of Bear Essentials. I: 34.22 ct cushion cut peacock sapphire from Sri Lanka. Photo by Robert Weldon/GIA, courtesy of Crown Color. J: Green and ice jade ring. Photo by Emily Lane, courtesy of Mason Kay.

K: 10.8 ct emerald cut bicolor sapphire. Photo by Robert Weldon/GIA, courtesy of Mayer and Watt. L: Gold in quartz from the Red Bank mine in California. Photo by Robert Weldon/GIA, courtesy of Stonetrust. M: 15.69 ct emerald cut rhodochrosite from Colorado s Climax mine. Photo by Robert Weldon/GIA, courtesy of Beija Flor Gems. N: The beryl variety vorobyevite, from Badakhshan Province, Afghanistan. Photo by Robert Weldon/GIA, courtesy of Stonetrust. O: Tarugo rubellite measuring 85 cm and weighing 82 kg (180 lbs.) from the Jonas mine in Minas Gerais, Brazil. Beside it are Richard Freeman (left) and James Elliott (right). Photo by Robert Weldon/GIA, courtesy of E.F. Watermelon and Co.

REGULAR FEATURES

COLORED STONES AND ORGANIC MATERIALS

Aquamarine from Pakistan. In recent decades, a steady supply of aquamarine has come from northern Pakistan, an increasingly important mining locality. The aquamarine was mined mostly from the Gilgit-Baltistan region, including the Shigar Valley, as well as the Hunza and Braldu Valleys (figure 40). The aquamarine occurs in zoned pegmatites formed by hydrothermal fluids in the cavities or veins (M.H. Agheem et al., "Shigar Valley gemstones, their chemical composition and origin, Skardu, Gilgit-Baltistan, Pakistan," *Arabian Journal of Geosciences*, Vol. 7, No. 9, 2014, pp. 3801–3814).

Most aquamarines from northern Pakistan show a long hexagonal prism habit and can reach up to a dozen centimeters in length (figure 41). Albite, muscovite, and tourmaline (schorl) are commonly associated as matrix, and most of these are collected as mineral specimens. Parts of them are gem quality and suitable for jewelry use.

Aquamarine samples from the Shigar Valley were obtained from local merchants who deal with Pakistani material. The samples displayed colors ranging from pale greenish blue and pale blue to nearly colorless, with a translucent to transparent appearance. The samples measured 1–2 cm in length and 0.5–1 cm in diameter. To explore the gemological and other properties of these samples, six of them (figure 42) were investigated by standard gemological methods as well as spectroscopic and chemical analyses at China University of Geosciences (Wuhan).

The following gemological properties were recorded: RI—n_o = 1.574–1.580, n_e = 1.569–1.575; birefringence—0.005–0.006; SG—2.60–2.72; UV fluorescence—weak bluish white to both long- and short-wave UV. The moderate to weak dichroism observed was a relatively saturated blue or greenish blue along the e-ray and very pale blue, greenish blue, or near-colorless along the o-ray.

Microscopic observation revealed abundant 20–300 μm inclusions, either two-phase (fluid, gas) or three-phase (one or two types of fluid, solid, gas) with various shapes. The irregularly shaped multiphase inclusions often gathered together to form a complex "fingerprint" network distributed along healed fissure planes (figure 43, top row). In addition, two-phase inclusions with elongated shapes parallel to the c-axis, and with hexagonal outer profiles perpendicular to the c-axis, were consistent with the crystalline symmetry of beryl (figure 43, bottom row).

These two kinds of multiphase inclusions formed by different crystallization processes. When the beryl crystal-

Figure 40. Map of the Gilgit-Baltistan region in northern Pakistan showing the main aquamarine deposits of the Hunza, Braldu, and Shigar Valleys.

Figure 41. The aquamarine crystal on feldspar from the Shigar Valley in Pakistan measures 17 cm tall. Photo by Joe Budd, courtesy of Arkenstone.

lized out of a hydrothermal fluid, some of the fluid was trapped. With dropping temperature during mineralization, beryl was re-deposited and a gaseous phase was released from the fluid, gradually forming single multiphase inclusions whose shape conformed to beryl's hexagonal symmetry. But the formation of multiphase "fingerprint-like" inclusions with irregular shape occurred later. Fluid was embedded in the fracture of the beryl crystal. Due to the solution and re-deposition of beryl from fluid on the fracture surfaces, a small amount of liquid and released gas were gathered and closed off, just like "fingerprint" or dendritic growth networks along healed fissure planes. For a detailed description of these processes, please refer to E. Roedder, "Ancient fluids in crystals," *Scientific American*, Vol. 207, No. 4, 1962, pp. 38–47.

Large amounts of multiphase inclusions could lead to a misty, translucent, and uneven appearance, such as the aquamarine crystal in figure 41, with a misty translucence toward the bedrock end. Generally, these characteristics can also be seen in aquamarine from other deposits in Brazil, the United States, South Africa, and China (D. Belakovskiy et al., *Beryl and Its Color Varieties: Aquamarine, Heliodor, Morganite, Goshenite, Emerald, and Red Beryl*, Lapis International LLC, East Hampton, Connecticut, 2005).

Multiphase and mineral inclusions were identified by Raman spectroscopy with 532 nm laser excitation. The gaseous phase was identified as a mixture of CO_2 and a small amount of methane (CH_4), and the fluid inclusion consisted of water with dissolved CO_2 or liquid CO_2. Solid phases inside the multiphase inclusions were identified as solid sulfur

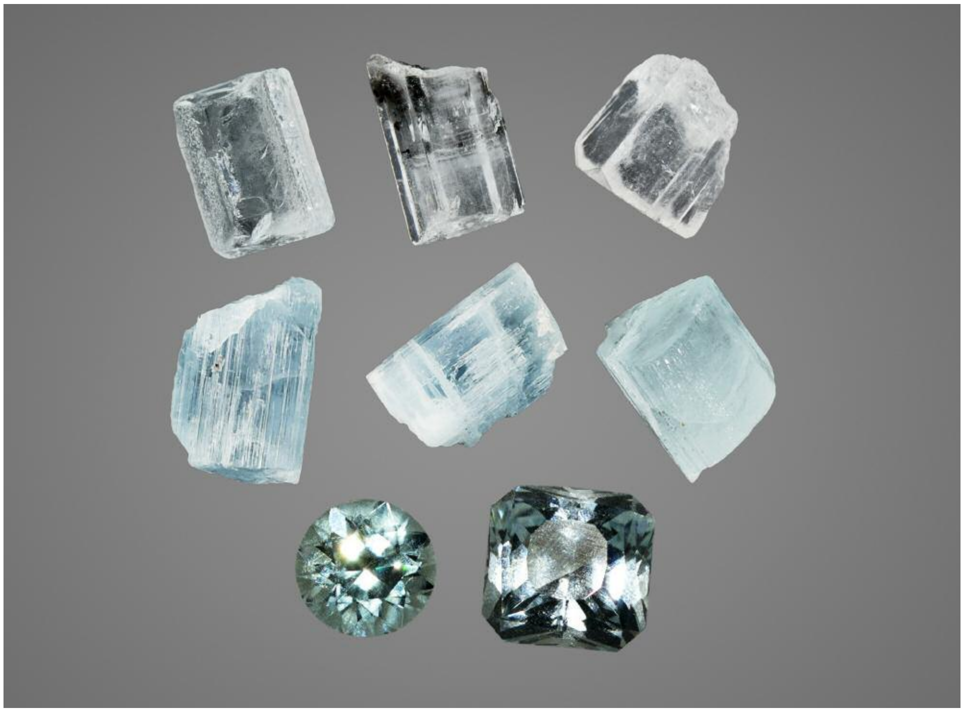

Figure 42. Six rough and two faceted aquamarines from Shigar Valley. The rough samples range from about 5 to 10 ct. The round brilliant cut weighs 3.82 ct, the square cut 7.91 ct. Photo by Yang Hu.

and orpiment. Along with columnar tourmaline, white albite, and flaky muscovite, other mineral inclusions such as orange-red almandine, brown tantalite, and yellow argentojarosite [$AgFe_3(SO_4)_2(OH)_6$] were identified by Raman.

Chemical analysis on aquamarine samples by laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS) showed the following ranges for alkali elements: Li 70–1240 ppmw, Na 830–3970 ppmw, K 54–453

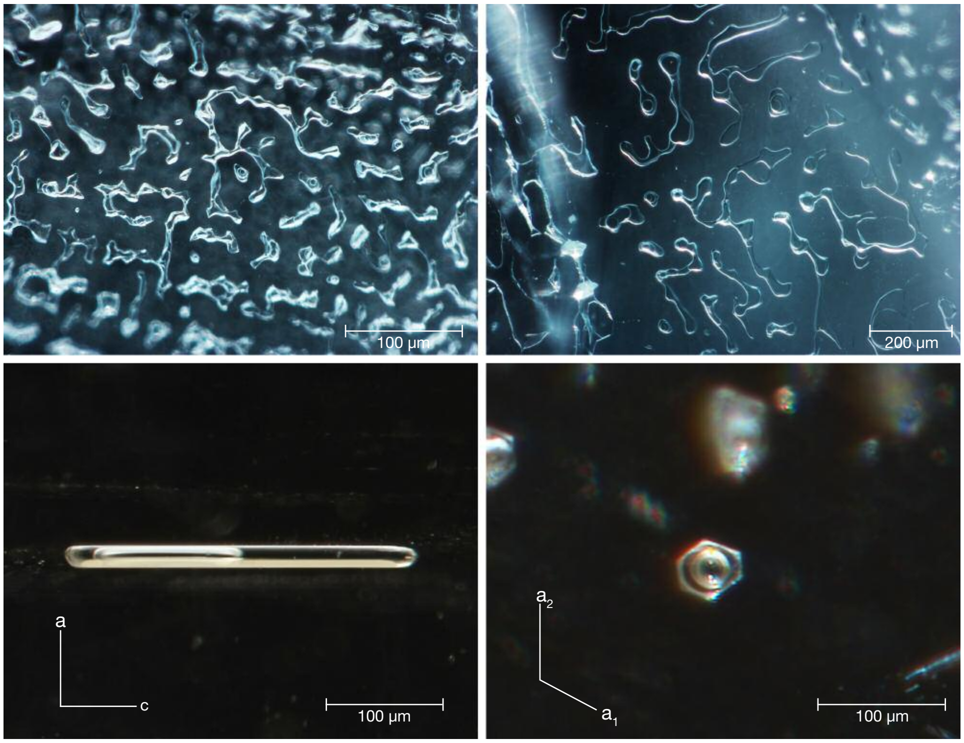

Figure 43. Multiphase inclusions in aquamarines from Shigar Valley. Top: Abundant two-phase and multiphase inclusions with irregular shape showing complex "fingerprint" networks. Bottom left: An elongated two-phase inclusion parallel to the c-axis. Bottom right: The same inclusion (shown in the bottom left image) viewed down the c-axis, presenting a perfect circular gas bubble and hexagonal outer profile consistent with the crystalline symmetry of beryl. Photomicrographs by Yang Hu.

Figure 44. Phenakite with beryl in mica (left) and yellow phenakite (right). Photos by Mikhail Popov; fields of view 5 cm.

ppmw, Rb 10–64 ppmw, and Cs 310–3220 ppmw. The amount of total alkali content including Li, Na, K, Rb, and Cs ranged from 1296 to 6033 ppmw. As alkali ions (mainly for Na) were associated with "type II" water molecules in structural channels (D.L. Wood and K. Nassau, "The characterization of beryl and emerald by visible and infrared absorption spectroscopy," *American Mineralogist*, Vol. 53, No. 5, 1968, pp. 777–800), the relatively low Na content was in agreement with the low peak intensity of "type II" H_2O revealed by Raman and IR spectroscopy. The low concentration of alkali content and lack of "type II" water in our aquamarine samples were similar to that in aquamarine from Italy and Vietnam (R. Bocchio et al., "Aquamarine from the Masino-Bregaglia Massif, Central Alps, Italy," Fall 2009 *G&G*, pp. 204–207; L.T.-T. Huong et al., "Aquamarine from the Thuong Xuan District, Thanh Hoa Province, Vietnam," Spring 2011 *G&G*, pp. 42–48). The chromophore Fe, responsible for blue color, was the richest among all transition elements between 1350 and 5080 ppmw; the samples showed the typical iron absorption at 375, 425, 620, and 820 nm in UV-Vis-NIR spectra. Transition elements V and Mn were present at 1–33 ppmw and 17–56 ppmw, respectively, and the bluish white fluorescence mentioned above may originate from Mn^{2+} or VO_4 centers (M. Gaft et al., *Modern Luminescence Spectroscopy of Minerals and Materials*, 2005, Springer Berlin, pp. 97–99). Chemical and spectral characteristic suggested the Pakistani samples were low-alkali aquamarine colored by Fe ions rather than irradiation (i.e., Maxixe beryl).

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Color origin of phenakites from the Ural emerald mines. Phenakite (Be_2SiO_4) was first discovered at Russia's Ural emerald mines, and was chemically identified in 1833. The mineral is widely distributed in beryllium deposits, but crystals of gem quality or large size are rare. At the Ural mines, however, there are large transparent crystals that can be used in jewelry. Jewelry-grade phenakite is generally colorless or yellowish brown (figure 44; see M.P. Popov et al., "Features of phenakite mineralization from the Ural emerald mines," *Bulletin of the Ural Branch of the RMS*, No. 13, 2016, pp. 105–111). The main mineral inclusions are chlorite, talc, phlogopite, actinolite, and ilmenite; fluid inclusions with a gas-liquid composition also occur.

The color origin of phenakite using optical absorption spectroscopy has not been studied in detail. Many authors agree that the coloration is associated with electron-hole centers (see A.S. Marfunin, *Spectroscopy, Luminescence and Radiation Centers in Minerals*, 1975, Nedra, Moscow). This is indicated by the disappearance of color when phenakite is exposed to either ultraviolet radiation or high temperatures. According to one theory of absorption, this is related to the oxygen vacancies that have captured electrons (again, see Marfunin, 1975). Other researchers believe that the absorption features are associated with bridging electronic centers such as Al-O-Al, which are formed by isomorphous replacement of silicon by aluminum ions in the crystal lattice, in amounts up to 0.5% (see A.N. Platonov, *Nature of Coloring of Minerals*, 1976, Naukova Dumka, Kiev).

To determine the color origin of yellow-brown phenakites, we obtained optical absorption spectra of colorless and yellow-brown phenakite from the Mariinsky deposit. These spectra were collected in the 185–700 nm wavelength range, at room temperature, on a specialized Shimadzu UV-3600 spectrophotometer. A broad absorption band was noted in the 225–325 nm range of the yellow-brown phenakite spectrum, with a maximum at 268 nm. Absorption in the ultraviolet range of the optical spectrum was not detected in transparent colorless phenakites (figure 45).

To study electron-hole centers and to reveal color centers in phenakite, crystals were examined using electron paramagnetic resonance (EPR). EPR is an informative method for studying dissymmetry of crystals, the role of the symmetry elements of the spatial group, and the distribution of impurity ions and point defects in the bulk of the crystal. Dissymmetry of crystals, as a result of the uneven distribution of point defects in the process of crystal growth, is a widespread phenomenon (see G.R. Bulka et al., "Dissymmetrization of crystals: Theory and experiment," *Physics and Chemistry of Minerals*, Vol. 6, 1980, pp. 283–293; R.A. Khasanov et al., "Derivation of the conditions for equivalent positions in crystals: The dissymmetrization of barite by electron spin resonance," *Crystallography Reports*, Vol. 57, No. 5, 2012, pp. 751–757; J.M. Hughes et al.,

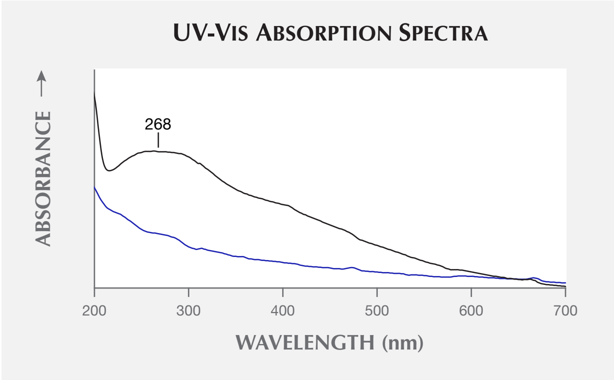
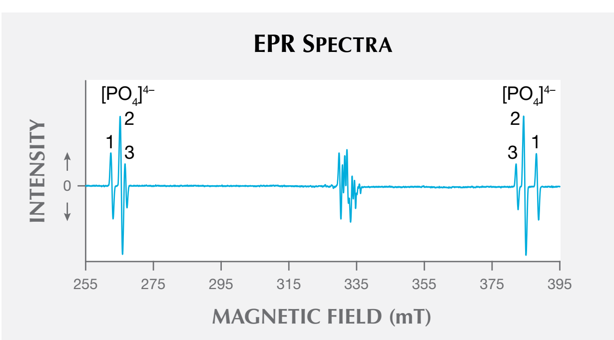


Figure 45. Absorption spectra of colorless phenakites (blue trace) and yellow-brown phenakites (black trace).

"Dissymmetrization in tourmaline: the atomic arrangement of sectorally zoned triclinic Ni-bearing dravite," *The Canadian Mineralogist*, Vol. 49, 2011, pp. 29–40). We used an Adani CMS8400 spectrometer (frequency ν=9, 4 GHz) at room temperature to perform EPR on our samples. During an experiment on the EPR spectra of the impurity radical $[PO_4]^{4-}$ phenakite of deposits in Volynskii (see A.I. Novozhilov et al., "Electron paramagnetic resonance in irradiated phenakite Be_2SiO_4," *Journal of Structural Chemistry*, Vol. 11, 1970, pp. 393–396), we found a difference in intensity of the lines of three magnetically nonequivalent centers for the impurity radical. The paramagnetic center $[PO_4]^{4-}$ was only detected in the yellow-brown crystals (figure 46), and active centers were absent in colorless specimens. From this we concluded that the origin of the yellow-brown color of phenakite is associated with a paramagnetic complex $[PO_4]^{4-}$ that produces absorption bands

Figure 46. Phosphorus ions replace silicon ions in a tetrahedral structure to form a $[PO_4]^{4-}$ complex in yellow-brown phenakites. This complex is paramagnetic and gives several signals in the range of 320–340 mT. Splitting of the hyperfine structure of the signal occurs; lines 1, 2, and 3 appear and indicate the existence of the $[PO_4]^{4-}$ radical. When the crystal rotates along its c-axis, it changes the intensity of these lines.



in the ultraviolet region, which in turn leads to the formation of this color in the mineral.

These results can be used in gemological identification of phenakites from the Ural emerald mines.

This study was performed in the context of the Russian Government Program of Competitive Growth of Kazan Federal University, "Paleogeodynamics and evolution of structural-material complexes in the formation of the continental-type crust ...," theme no. 0393-2016-0019.

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Freshwater natural pearls from the Concho River, Texas. Throughout history, natural pearls have been found in many species of freshwater mollusk in North American lakes and rivers. They are most abundant within the Mississippi River drainage basin, which provides the perfect habitat for these animals because of the large watershed areas with their underlying limestone substrata (J.L. Sweaney and J.R. Latendresse, "Freshwater pearls of North America," Fall 1984 *G&G*, pp. 125–140). Lesser-known sources of natural freshwater pearls are the Colorado River and Brazos River and their tributaries in the state of Texas. However, the best samples are sometimes found in a species named Tampico Pearlymussel (*Cyrtonaias tampicoensis*) that inhabits the Concho River in West Texas.

The mollusk is distributed from northeastern Mexico into the Concho, Colorado, and Brazos Rivers of central Texas and has been collected by licensed harvesters. Mussel harvesting is restricted to hand collection only, and there is a legal minimum shell size requirement. In addition, several areas in Texas have been designated mussel sanctuaries in order to provide protection and species conservation (R.G. Howells, "The Tampico pearlymussel (*Cyrtonaias tampicoensis*), shades of the Old West," http://www.conchologistsofamerica.org/articles/1996/the-tampico-pearlymussel.html). Pearlers find mussels by wading into water that is three to four feet deep and feeling for the shells with their toes. Rattlesnakes on the banks and water moccasins and snapping turtles in the murky water (J. Morthland, "Irregular radiance: The rare beauty of Conch River pearls," *Texas Highways*, April 2015) pose risks to these adventurers searching for gems.

GIA's New York laboratory recently received nine loose pearls from Stone Group Laboratories (Jefferson City, Missouri) for a joint study. The pearls ranged in size from 2.95 × 2.45 mm to 14.76 × 13.55 × 13.13 mm. Reportedly recovered from Tampico pearlymussel shells taken from the Concho River, they exhibited colors ranging from purplish pink to orangy pink. Some of the samples also possessed varying degrees of a brownish hue (figure 47). Most of the

Figure 47. Nine "Concho" pearls examined in this study together with a Tampico pearlymussel shell. The shell measures approximately 12 × 8 cm. Pearls range from 0.12 to 16.59 cts. Photo by Sood Oil (Judy) Chia.

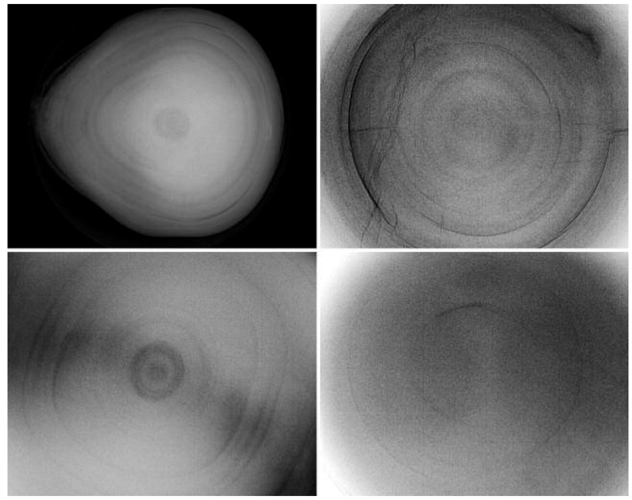
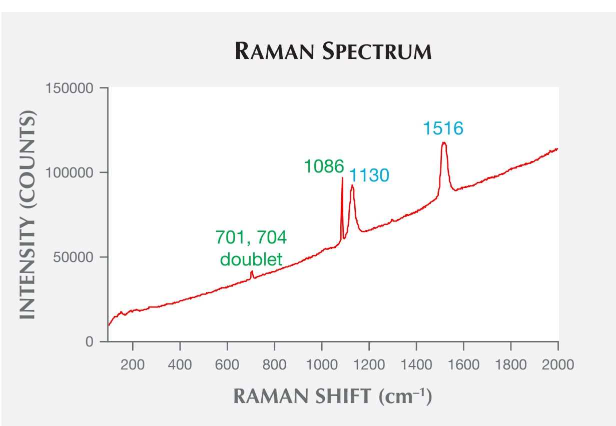


Figure 48. The pearls' internal structures showed typical natural concentric growth arcs, while some also exhibited dark organic-rich centers and natural internal cracks.

small pearls in the group exhibited a dull chalky appearance, with some broken or cracked areas of the nacreous surface. The largest pearl in the group (16.59 ct) showed good nacre condition, a high luster, and noticeable orient on its surface.

The internal structures of the pearls were analyzed by real-time microradiography, and the majority revealed typical concentric natural growth arcs (figure 48). Dark organic-rich centers were also seen in some of the pearls, as well as internal fissures, cracks, or growth boundaries. There were no indications of bead nuclei or non-bead cultured features (irregular linear or void structures). Additional advanced techniques such as X-ray fluorescence imaging and energy-dispersive X-ray fluorescence (EDXRF) spectrometry revealed noticeable X-ray luminescence and high manganese content, confirming the pearls' freshwater origin. Furthermore, Raman spectroscopic analysis of all the pearls detected polyacetylenic compounds (figure 49); these are natural pigments responsible for the colors of many freshwater and some saltwater pearls.

Figure 49. Raman spectrum of a "Concho" pearl showing polyacetylenic pigment-related peaks at 1130 and 1516 cm^{-1} and peaks at 1086, 704, and 701 cm^{-1} (the latter two a doublet) of structural calcium carbonate in the form of aragonite.



The study provided GIA with a rare opportunity to study this unique group of freshwater natural pearls originating from the southwestern United States. Both gemological and analytical data were consistent with their claimed natural and freshwater origin. Pearls produced from this locality often possess beautiful fancy pink, purple, or lavender colors (Summer 1989 GNI, p. 115; Fall 2005 Lab Notes, pp. 259–260), as demonstrated by these examples.

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Very small akoya cultured pearls. Akoya cultured pearls are produced by the *Pinctada* genus, specifically *Pinctada fucata* (*martensii*). The mollusk and closely related species are found in the seas off Japan, China, South Korea, and Australia, as well as in the Mediterranean and Arabian Gulf and in the waters of other countries between the Tropic of Cancer and the Tropic of Capricorn such as Vietnam and India.

Akoya pearl farming was first established in the Mie Prefecture in Japan by Kokichi Mikimoto more than a century ago and still exists there to this day. Other suitable locations in Japan such as the waters off the islands of Shikoku and Kyushu, as well as pearl farms in other parts of the world such as Bai Tu Long and Ha Long Bays in the north of Vietnam and in the waters along the southern coast of China from Leizhou peninsula to the border of Vietnam also produce cultured akoya pearls. The round nuclei are commonly fashioned from freshwater shell imported from the USA (T. Hsu et al., "Freshwater pearling in Tennessee," 2016, https://www.gia.edu/gia-news-research/freshwater-pearling-tennessee). The technicians who insert the nuclei usually surgically maneuver one or two bead nuclei, ranging from 1.5 to 1.7 mm, into position within the gonad using a piece of mantle tissue from a donor mollusk to produce the bead-cultured pearls. Akoya mollusks are typically left in the water for 10 to 14 months. The best harvesting time is in the winter season, when cooler temperatures ensure the mollusks produce nacre slowly and more tightly, yielding the highest luster possible in akoya pearls before any processing is applied. Akoya bead-cultured pearls are typically round and range from 2 to 11 mm in diameter, with the most common sizes between 6 and 8 mm.

During the formation of bead-cultured pearls, the accidental formation of some non-bead cultured pearls (NBC), sometimes referred to as "keshi" pearls, may also take place. Those produced by the akoya mollusk are generally very small (the word "keshi" translates in Japanese to "poppy seed").

GIA's Bangkok laboratory examined a short strand of what were supposedly the smallest commercially produced akoya bead-cultured pearls available today, together with a selection of randomly picked NBC pearls from the same origin (figure 50), all loaned by Orient Pearl Company. The pearls and the shell reportedly came from Vietnam, and the author was informed that the shell used to culture the pearls was *Pinctada fucata* (*martensii*). The graduated strand, consisting of 42 very small bead-cultured pearls, weighed 4.68 ct total, and the pearls ranged from 1.90 to 3.17 mm. Also examined were nine tiny shell bead nuclei between 1.59 and 1.74 mm and weighing 0.30 carats total, as well as 67 loose akoya NBC pearls, ranging from 0.80 mm in diameter to 2.82 × 1.91 × 1.75 mm and weighing 2.31 carats total. The akoya bead-cultured pearls in the strand were round and near-round with a predominantly cream color. The NBC pearls were mostly baroque and predominantly white, with some cream and light gray samples.

Although observation down the drill holes with a loupe indicated bead-cultured pearls, real-time X-ray microradiography (RTX) proved this beyond any doubt. A clear bead nucleus was visible in each pearl (figure 51). Characteristic small voids and/or organic features seen in many bead-cultured pearls were present in some cases between the shell bead nucleus and nacre overgrowth. Banded structure within the beads and/or differences in radio-opacity between the shell bead nuclei and nacre were other characteristic features of bead-cultured pearls noted when the pearls were examined at higher magnification. Measurements of five randomly selected pearls revealed nacre thicknesses from 0.20 to 0.41 mm, within the usual commercially accepted range (0.15–0.50 mm) expected for akoya bead-cultured pearls. The majority of the larger pearls showed very good nacre thickness, and none of them were below the minimum standard that might lead to durability concerns.

Figure 50. The graduated strand of small akoya bead-cultured pearls with nine tiny shell bead nuclei and loose akoya NBC pearls next to a Pinctada fucata (martensii) *akoya shell. Photo by Nuttapol Kitdee.*

Figure 51. RTX analysis revealed the round shell bead nuclei used in the production of the bead-cultured pearls in the strand. A typical-size (7.70 mm) akoya bead-cultured pearl is shown in the center for comparison. Image by Promlikit Kessrapong.

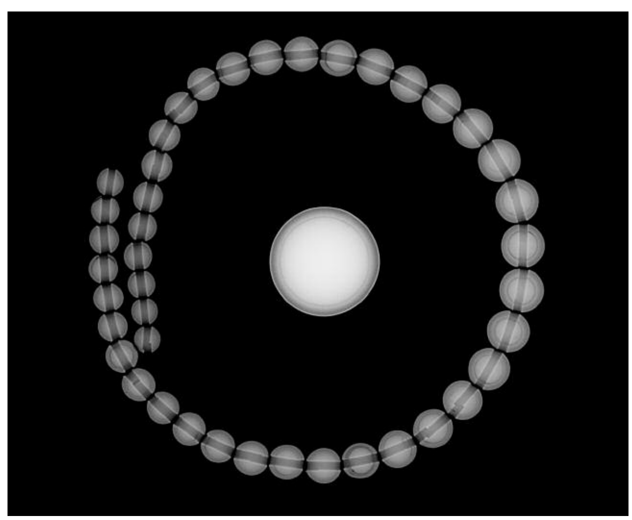
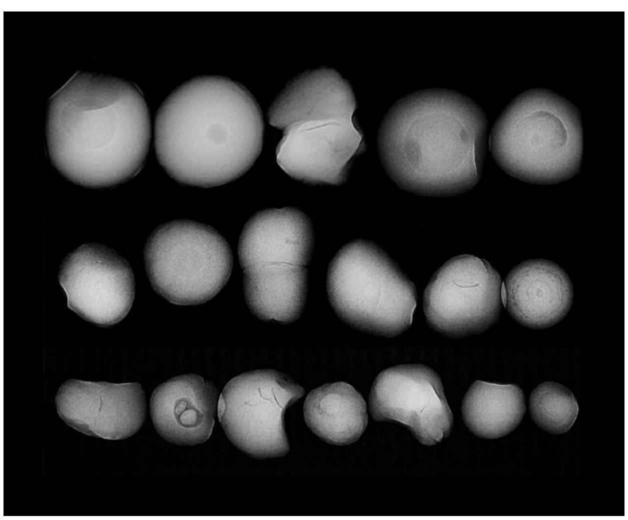


Figure 52. RTX analysis of tiny loose akoya NBC pearls revealed void-like structures in most of them. Image by Promlikit Kessrapong.

RTX analysis of the loose NBC pearls revealed typical void-like structures expected for akoya NBC pearls in most of the samples (H.A. Hänni, "A short review of the use of 'keshi' as a term to describe pearls." *Journal of Gemmology*, 2006, Vol. 30, pp. 51–58; N. Sturman, "The microradiographic structures of non-bead cultured pearls," 2009, https://www.gia.edu/gia-news-research-NR112009). Those with less-defined structures needed further RTX analysis in additional directions to find sufficient evidence of their claimed origin (figure 52).

Figure 53. RTX analysis of some of the smallest pearls, claimed to be NBC, revealed structures more consistent with natural pearls. Image by Kwanreun Lawanwong.



After additional RTX analysis in other directions, some of the more questionable structures showed features that were clear enough to consider as NBC. Most of the smallest pearls from the group revealed structures that were not consistent with those commonly seen in NBC pearls. Their "meaty" structures, central rounded dark organic features, and/or boundary or fold lines (seen in multi-nuclei/part pearls such as twins or aggregates) are in fact more typical of natural saltwater pearls (figure 53). Advanced analysis such as X-ray computed microtomography (μ-CT) may be required in these difficult cases, but owing to their very small sizes, obtaining clearer imagery is impractical. In this case, the lab gemologists did not find enough evidence to identify these pearls as non-bead cultured. Since most pearls are submitted without any information and laboratory gemologists have to go by what they see, such pearls would likely be considered natural, even if they are not such by definition. This clearly shows the challenges faced by gemologists carrying out pearl identification on some client-submitted items.

Areeya Manustrong
GIA, Bangkok

TREATMENTS

Irradiated and annealed blue type Ia diamond. Many diamonds are subjected to artificial radiation, usually with subsequent annealing to create attractive colors. Most blue diamonds in the market are treated by artificial irradiation, yet irradiated blue diamonds with a multi-step treatment process are rarely seen in the lab. The National Center of Supervision and Inspection on Quality of Gold and Silver Products (Nanjing, China) recently examined such an example.

The 0.36 ct round brilliant, graded as fancy deep green-blue (figure 54), had natural mineral inclusions under the table and a fracture near the girdle. The DiamondView image showed a ring-like natural growth pattern (figure 55). The infrared spectrum revealed the diamond was type IaAB, with absorptions at 1282 cm^{-1} and 1175 cm^{-1} (A-aggregated nitrogen and B-aggregated nitrogen, respectively); the spectrum also revealed a radiation-related peak at 1450 cm^{-1} (figure 56). The H1a center reflected by the 1450 cm^{-1} band, involving a single nitrogen atom and two equivalent carbon atoms, was formed by irradiation and annealing above 300°C for diamonds with aggregated nitrogen (type Ia) (I. Kiflawi et al., "Nitrogen interstitials in diamond," *Physical Review B*, Vol. 54, No. 23, 1996, pp. 16719–16726). The UV-Vis-NIR absorption spectrum showed absorption from a GR1 defect at 741.2 nm and revealed weak absorptions from a defect of uncertain structure (594.4 nm), H3 (503.2 nm), and H4 (496.2 nm) centers (figure 57). The GR1 center, believed to be a neutral vacancy (V^0) defect, is a typical radiation-induced defect; the vacancies begin to move at 500°C and the GR1 center begins to decrease until it disappears, at around 800°C (A.T. Collins,

Figure 54. This 0.36 ct Fancy Deep green-blue diamond is a multi-step treated diamond. Photo by Wenqing Huang.

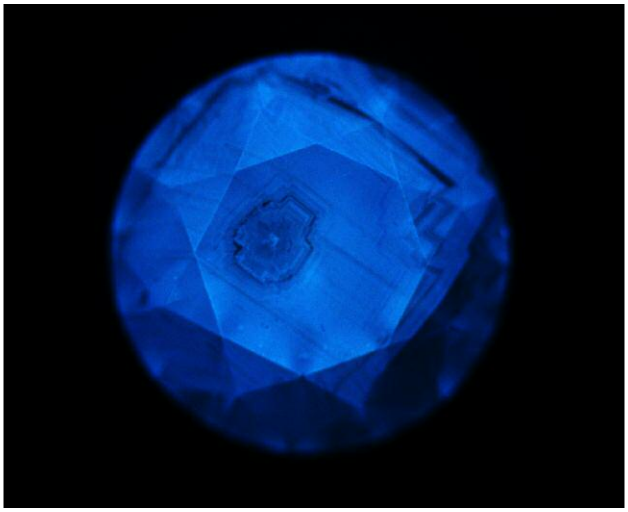


Figure 55. The DiamondView image showed a characteristic ring-like natural growth pattern. Image by Wenqing Huang.

"Investigating artificially coloured diamonds," *Nature*, Vol. 273, No. 5664, 1978, pp. 654–655). The 595 nm center is also a typical radiation-induced center, which appears at temperatures above 300°C after radiation (Collins et al., 1978). The presence of the H3 and H4 centers was confirmed with photoluminescence (PL) spectroscopy (figure 58). The combination of all the above defects, especially the strong H1a center, indicates that the diamond was subjected to irradiation followed by annealing.

Natural near-colorless type Ia diamonds are known to be artificially irradiated to introduce blue to green color by displacing carbon atoms in the lattice to create vacancies. Annealing could be used to change the lattice defect configuration, especially GR1, to achieve a purer blue (C.M. Breeding, "A spectroscopic look at green and blue gem diamonds colored by artificial irradiation treatment," presentation at Geological Society of American 2014 annual meeting). After annealing above 500°C, the vacancies start

Figure 56. The FTIR spectrum of the 0.36 ct irradiated diamond revealed the sample was type IaAB, with absorptions at 1282 cm^{-1} (A-aggregated nitrogen) and 1175 cm^{-1} (B-aggregated nitrogen). The H1a absorption at 1450 cm^{-1}, associated with irradiation and subsequent heating, was also detected. In addition, the spectra showed peaks at 1405, 1096, and 1010 cm^{-1}, all of which are usually seen in type Ia diamond.

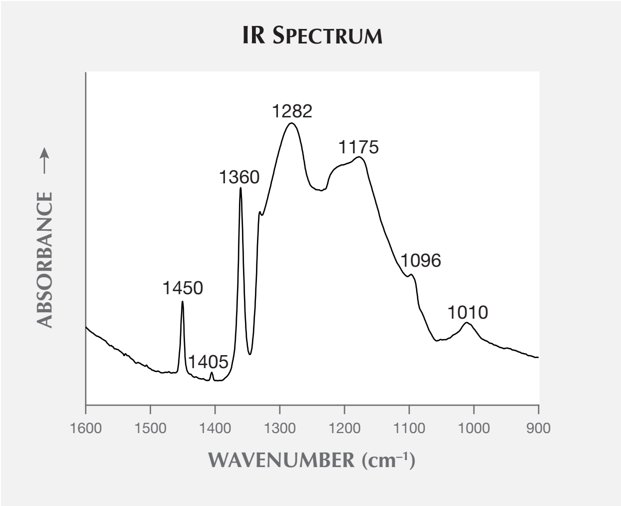
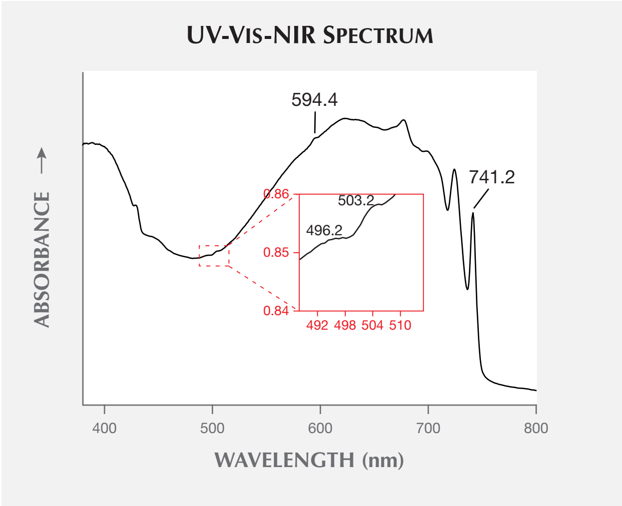


Figure 57. The UV-Vis-NIR spectrum of the 0.36 ct irradiated diamond, collected at liquid nitrogen temperature, showed a clear GR1 center defect at 741.2 nm, and weak absorption lines at 594.4 nm, 503.2 nm, and 496.2 nm.



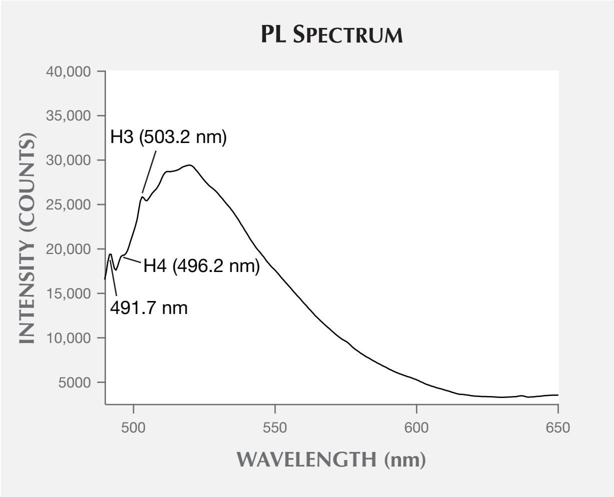


Figure 58. The PL spectrum of the sample excited with a 405 nm laser showed weak emissions at 496.2 nm (the H4 center) and 503.2 nm (the H3 center). A peak at 491.7 nm was also detected.

to migrate, and can be captured by nitrogen centers to create the H1a center (B. Dischler, *Handbook of Spectral Lines in Diamond, Volume 1: Tables and Interpretations*, Springer-Verlag, Berlin, 2012, pp. 315–316). To the best of our knowledge, this is the first diamond examined in China that has been irradiated and annealed to introduce a blue color.

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INSTRUMENTS

Universal Microscope Upgrade Kit. Israel-based GemoAid recently released the Universal Microscope Upgrade Kit (figure 59). Designed by gemologist Guy Borenstein, it offers a variety of accessories that maximize the use of a standard gemological microscope when observing unknown gems. The kit includes four mounting rings and two extension rods, which should be compatible with almost any microscope that has transmitted light capabilities. Also included are two polarizing filters, a blue filter, a yellow filter, a diffuser plate, and an immersion cell. The product, which retails for US$130, also includes a one-year warranty from the date of purchase.

The combination of components allows the microscope to act as a polariscope for making critical optical observations of gemstones and their inclusions. The colored filters and diffuser plate can also facilitate observation of subtle color zoning features such as curved color bands in yellow flame-fusion sapphires, which would be diagnostic of their manmade origin and difficult to resolve without a blue filter.

The unit examined by the author was found to be a little loose where the metal rod attaches to the mounting ring. The author also found the immersion cell to be too tall, making it difficult to manipulate small stones with tweezers—which is quite critical in immersion microscopy—but certainly the larger cell will accommodate larger stones and perhaps rough crystals.

Overall, the quality and price of the upgrade kit are well matched. It is of great value to the serious gemologist.

Nathan Renfro
GIA, Carlsbad

Figure 59. GemoAid's new Universal Microscope Upgrade Kit converts a gemological microscope into a polariscope, while the colored filters and diffuser plate are useful in observing subtle color zoning features. Photo by Kevin Schumacher.

CONFERENCE REPORTS

Fourth International Diamond School. At the end of January 2018, some 92 attendees and 18 teachers gathered once again in the picturesque northern Italian town of Brixen-Bressanone for the fourth International Diamond School (IDS), themed "Diamonds: Geology, Gemology, and Exploration."

As in previous years, the school was underwritten by the Gemological Institute of America (GIA) in addition to the Deep Carbon Observatory (DCO), the Society of Italian Mineralogical (SIMP), and the University of Padua. Profes-

Figure 60. During the Fourth International Diamond School, Pierre Cartigny delivers a presentation on stable isotopes with support from organizer Fabrizio Nestola. Photo by Marco Cuman.

sor **Fabrizio Nestola** (University of Padua) served as local organizer extraordinaire and was assisted on the organizing committee by four of the presenters: **Matteo Alvaro**, **Graham Pearson**, **Steven Shirey**, and **Wuyi Wang**.

The academic activities took place in a well-appointed auditorium owned by the University of Padua, while meals and social activities were held in the sixteenth-century Hotel Elephant—so named because the original building saw the arrival of an elephant from Ceylon—a gift to the Austrian royal family that caused a sensation and inspired artists and poets.

For the first three days, the school provided a general overview of the recent advances in diamond research, focusing specifically on the geology, exploration, and gemology of diamond from leading scientists in their fields. A brief summary of their talks follows.

Jeffrey Harris (University of Glasgow, UK) gave a very interesting overview of the history of gem diamonds from the sixth century (AD) onward. The modern era, leading directly to today's active mines, began in the 1870s in South Africa with the discovery of rich placer deposits. This period was followed by recognition of kimberlite as the diamond host rock and the battle between Barnato and Rhodes for supremacy over the kimberlite pipes in the Kimberly area.

John Armstrong (Karowe Mine, Lucara Diamond, Botswana) is the world's expert on how to extract (and not break!) very large diamonds. He outlined automated methods such as X-ray transmission to detect low-nitrogen stones and crushing methods that use the host kimberlite itself to minimize breakage.

Herman Grütter and **Jennifer Pell** (Peregrine Diamonds, Vancouver) spoke via Skype about microdiamond size frequency distributions (SFDs) and their practical use in macrograde forecasting to predict whether it will be economically worthwhile to mine a kimberlite. Each large sample of diamondiferous kimberlite dissolved by caustic fusion has its own microdiamond distribution in a plot of diamond grade (diamonds per ton) versus diamond size (carat weight). This negative correlation can be shown to merge with the same macrodiamond distribution for mines, which becomes the basis for the forecast. The challenge is that not all localities follow this relationship.

In a second Skype talk, Grütter spoke about pyroxene thermobarometry and a xenocryst-based approach. Using single clinopyroxenes from concentrates and indicator minerals, exploration major tectonothermal events in the mantle lithosphere are revealed. Because it takes some 800 million years for the lithosphere to equilibrate thermally, large clinopyroxene data sets can reveal heretofore unknown C-O-H flux fronts and mantle plumes.

Bruce Kjarsgaard (Geological Survey of Canada) discussed experimental constraints on kimberlite origin, ascent, and eruption. His talk focused on kimberlite mineralogy and isotopic compositions for kimberlite origin and experimental petrology for ascent and eruption. One of the basic questions still unanswered is whether kimberlite magmas are initially carbonatitic melts or some form of transitional melt.

Nikolay Sobolev (V.S. Sobolev Institute of Geology and Mineralogy, Novosibirsk, Russia) spoke about inclusions in Siberian diamonds and their polycrystalline aggregates and specific features of orogenic diamonds from Kazakhstan. His talk offered a useful review of inclusion types.

Making and stabilizing the deep diamond-bearing roots of the continents was the subject of a cutting-edge review by **D. Graham Pearson** (University of Alberta, Canada). Rheology turns out to be more important than buoyancy in preserving continental roots, and this stiffness makes them essentially plume-erosion proof. Lateral compression serves as a means to accumulate residues of any origin and form thick depleted lithosphere of more depleted composition. The process also accounts for late Archean intracrustal differentiation. A good modern analog to Archean craton formation may be seen in the new continent of Zealandia.

Thomas Stachel (University of Alberta) covered the entire subject of diamond formation in the earth's mantle. The newest thinking on diamond formation places less emphasis on solid-solid reactions or host-rock buffering and more emphasis on the diamond-forming fluids themselves. Critical factors include temperature change, reduction of CO_2, and presence of organic species including methane.

Oded Navon (The Hebrew University of Jerusalem) addressed diamond-forming fluids. He made the important points that there is a huge diversity of diamond-forming fluids by major and trace element composition and that the gem fluids are little different from those for fibrous diamonds.

Steven Shirey provided a framework with which to categorize diamond ages that can be used to establish meaningful age uncertainties with his talk. Since diamond ages rely on mineral inclusions for dating, debate over the years has been focused on whether these inclusions are protogenetic (existing before encapsulation) or syngenetic (simultaneous growth of the diamond and the inclusion). It is clear that many inclusions are mineralogically protogenetic while being geologically syngenetic.

Matteo Alvaro (University of Pavia, Italy) detailed new approaches to in-situ crystallographic study of mineral inclusions in diamond. Interestingly, mechanical re-orientation is a feature of the encapsulation of many silicate inclusions.

Pierre Cartigny (Institut de Physique du Globe de Paris; figure 60) discussed stable isotopes and diamonds in a talk that argued for massive carbon recycling into the mantle and considered the fractionation effects that occur between C, N, and the various kinds of fluids and sources from which well-studied diamond suites have come.

Diamond gemology and advanced technologies to replace visual observations were discussed by **Wuyi Wang** (GIA, New York). The talk covered GIA's research role in the $80 billion diamond trade and its assessment of color, cut, clarity, and carat weight. Dr. Wang also discussed GIA's internships and fellowships for research scientists.

Christopher M. Breeding (GIA, Carlsbad, California) covered the ever growing field of diamond defects and the identification of color treatment. While sophisticated analytical techniques allow GIA to associate color and treatment with lattice-scale mechanisms in diamond, each color requires considerable research analysis to pin down its defect mechanism.

Ulrika D'Haenens-Johansson (GIA, New York) addressed the synthesis of manmade gem diamonds and their detection. Diamonds grown by the two main methods—high-pressure, high-temperature (HPHT) growth and chemical vapor deposition (CVD)—currently can be detected chiefly from their isotopic composition and the N content of their starting compounds.

In her review of advances in in-situ isotope measurement in diamond and their inclusions, **Emilie Thomassot** (CNRS, Nancy, France) went over many of the theoretical and practical considerations affecting the accuracy and precision of ion microprobe measurements for stable isotopes, especially sulfur.

Steven Reddy (Western Australian School of Mines at Curtin University) described an exciting new direction in his talk on atom probe microscopy and its potential applications to diamond research. With this instrument, the analytical specimen is prepared in the shape of a needle and atoms from it are directed into a time-of-flight (TOF) mass spectrometer. One can retrieve the exact position of the atoms in the structure and even measure their isotopic composition. The potential is there to look at very tiny inclusions in diamond in this manner.

Dan Howell (University of Padua, Italy) covered the major uncertainties of Fourier-transform infrared (FTIR) studies of diamonds and how to overcome them. This basic technique, applicable nondestructively to any diamond, remains one of the most important ways to characterize specific diamonds and their integrated thermal history.

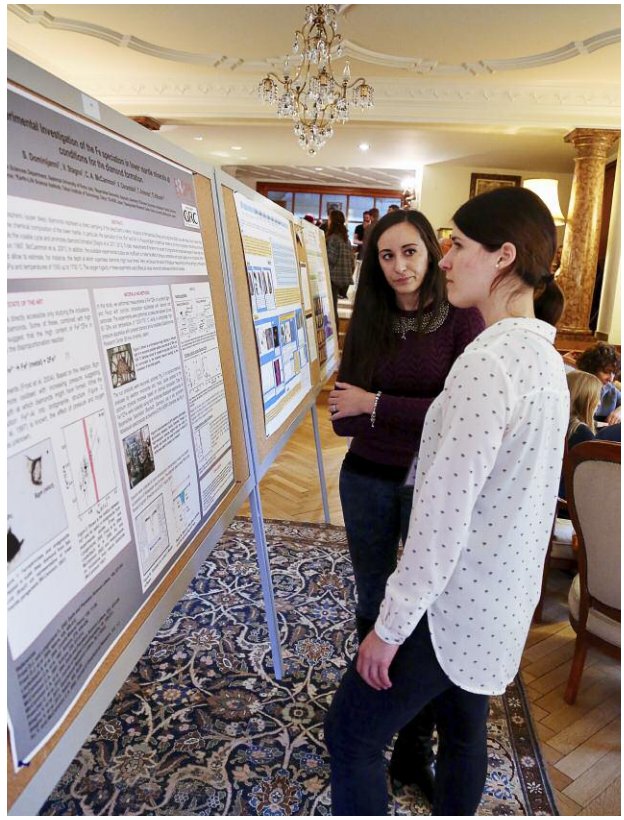

Figure 61. International Diamond School attendees discuss recent research. Photo by Marco Cuman.

Following the tradition of previous years, the International Diamond School went beyond these formal lectures (figure 61) to include practical sessions focused on microscopic observations of a complete inclusion-bearing diamond collection on the fourth day. The collection was made available to the IDS by Professor Jeffrey Harris, with microscopes provided by Zeiss and a micro-Raman spectrometer provided by Horiba Scientific.

The fifth day was devoted to 15-minute talks by students and early-career researchers providing the latest snapshot of their most recent work.

The Fourth International Diamond School was a fantastic opportunity to learn, exchange ideas, and inspire career choices. GIA's financial support reduced costs for students, and its sharing of expertise in diamond spectroscopy, diamond treatment, substitution and defect mechanisms, and grading gave the IDS an invaluable industry connection. GIA researchers were active participants throughout the week and inspired the students with their practical experience in the real world of gem diamonds.

The organizers and supporters were especially pleased with the diversity this year. The school had 110 participants from 13 different countries (Canada, Italy, Germany, France, the UK, Austria, the Netherlands, the United States, Russia, Israel, South Africa, Ireland, and Australia). There was a nearly even mix of undergraduate students,

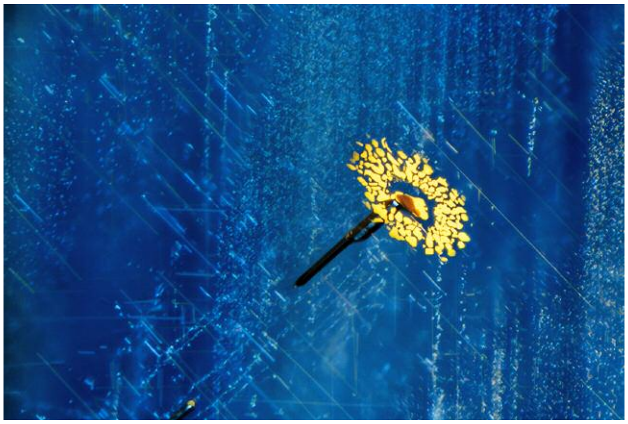

Figure 62. This inclusion scene showing a growth blockage and thin-film rosette within a Sri Lankan sapphire was enhanced by modified Rheinberg illumination to resemble a flower in a rainstorm. The image won the Internal and Overall categories in Gem-A's annual photography competition and earned Jonathan Muyal the Photographer of the Year award. Field of view 1.34 mm.

Ph.D. students, academic seniors, and industry figures. There was also a nearly equal gender balance, with 45 women and 47 men.

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Washington, DC

ANNOUNCEMENTS

Gerd Dreher (1939–2018). The gem world mourns the loss of master carver Gerd Dreher of Idar-Oberstein, Germany. Dreher was legendary for his lifelike and meticulously detailed carvings of flora and fauna. Dreher and his family, which has worked with gem materials for 13 generations, were profiled in the Winter 2017 issue (pp. 404–422).

Figure 63. Muyal also won Gem-A's Humanity in Gems category with this photo of a miner after finishing for the day at a sapphire deposit near Ilakaka, Madagascar.

Jonathan Muyal named Gem-A's Photographer of the Year. Thanks to a stunning photomicrograph revealing the inclusion scene of a Sri Lankan sapphire, Carlsbad staff gemologist and *G&G* contributor Jonathan Muyal has been named Gem-A's 2017 Gemstone Photographer of the Year. The winning shot—which also took top honors in the competition's Internal category, dedicated to photomicrography—shows a growth blockage resulting in an elongate tube terminating in a rosette-like thin-film fluid inclusion. By applying modified Rheinberg illumination with blue and yellow filters, Muyal achieved the appearance of a flower caught in a rainstorm (figure 62). The image was the subject of a Fall 2017 Micro-World entry (p. 371).

Muyal was also the winner of the Humanity in Gems category, which focuses on scenes of people mining, dealing, or otherwise working with gemstones. Muyal's photo shows a Malagasy miner who has finished a day's work at a sapphire deposit near Ilakaka (figure 63).

The Photographer of the Year competition is open to all Gem-A members and students.